THE

# FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 50. Thursday, January 25, 1934. No. 910.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

## Contents.

| | PAGE |
|---|---|
| Forthcoming Events | 69 |
| Foundry Propaganda | 69 |
| Art and Industry | 69 |
| Correspondence | 70 |
| Publication Received | 70 |
| Random Shots | 70 |
| Developments in Foundry Refractories | 71 |
| The Addition of Non-Ferrous Metals to Cast-Iron | 73 |
| Design and the Foundry | 75 |
| Steels in Marine Engineering Service | 76 |
| N.I.E.F. Annual Meeting | 76 |
| New Electromagnetic Vibrating Screens for Alternating Current Supply | 77 |
| Foundry Selling Practice | 78 |
| This Week's News in Brief | 79 |
| Trade Talk | 79 |
| Contracts Open | 79 |
| New Companies | 79 |
| Personal | 79 |
| Obituary | 79 |
| Company Reports | 79 |
| Applications to Register Trade Marks | 79 |
| Raw Material Markets | 80 |
| Patent Specifications Accepted | 80 |

**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN, THE NATIONAL IRONFOUNDING EMPLOYERS' FEDERATION, THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.**

***Institute of British Foundrymen.***

**PRESIDENT: 1933-34.**

**C. E. Williams, "Coniston," Cefn-Coed Road, Penylan, Cardiff.**

**LIST OF SECRETARIES—**

**General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.**
**Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.**
**Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.**
**Scottish: J. Bell, 60, St. Enoch Square, Glasgow.**
**Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.**
**London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.**
**Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.**
**East Midlands: H. Bunting, 82, Otter Street, Derby.**
**West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.**
**Wales and Monmouth: J. J. McClelland, "Clydesdale," Dover Street, Bilston, Staffs.**
**Middlesbrough: F. A. Harper, Station Chambers, Middlesbrough.**

***National Ironfounding Employers' Federation.***

**President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.**

***Foundry Trades' Equipment and Supplies Association.***

**President: R. H. Brackenbury, 13, Victoria Street, London, S.W.1.**
**Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.**

***Welsh Engineers' and Founders' Association.***

**President: W. E. Clements, Morfa Foundry, New Dock, Llanelly.**
**Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.**

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
*Telephone: Central 1895. Telegrams: CIRA.*
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

## Forthcoming Events.

FEBRUARY 8.

*Institute of Metals (London Local Section)*:—Meeting at 83, Pall Mall, London, at 7.30 p.m. "Electric Annealing and Heat-Treatment Furnaces," Paper by A. G. Lobley.

FEBRUARY 9.

*Institute of Metals (Sheffield Local Section)*:—Meeting at the University, St. George's Square, at 7.30 p.m. "Recovery and Refining of Precious Metals," Paper by H. G. Dale.

**Institute of British Foundrymen.**

FEBRUARY 3.

*Lancashire Branch*:—Annual whist drive, dinner and dance, at Grand Hotel, Manchester.

*Scottish Branch (Falkirk Section)*:—Meeting at Falkirk Technical School at 6 p.m. "Metallography of Iron," Paper by N. A. W. Erskine.

FEBRUARY 7.

*Lancashire Branch (Preston Section)*:—Meeting at 7.30 p.m. "Refractories and their Application," Paper by J. Masters.

*London Branch*:—Meeting at Charing Cross Hotel at 8 p.m. "Porosity in Non-Ferrous Metal Castings," Paper by G. L. Bailey.

FEBRUARY 9.

*Middlesbrough Branch*:—Meeting at the Cleveland Scientific and Technical Institute at 7.45 p.m. "Some Notes on Special Steel Production—Historical, Manufacture, Properties, Defects," Paper by J. N. Kilby.

*Birmingham, Coventry and West Midlands Branch*:—Meeting at the James Watt Memorial Institute, Birmingham, at 7.30 p.m. "Patternmaking," Paper by F. C. Edwards.

FEBRUARY 10.

*Scottish Branch*:—Meeting at Royal Technical College, Glasgow, at 4 p.m. "The Value of Temperature Control in Metallurgical Practice," Paper by Prof. Robert Hay.

## Foundry Propaganda.

A book of outstanding importance is a Symposium on Cast Iron, published by the American Foundrymen's Association. Actually, it is a concise statement of what cast iron is and what its potentialities are as a material for engineering constructions. It is exactly the type of book that should be in the hands of every designer, and it is the intention of the issuing association that founders should buy large quantities for distribution to engineers. Whilst its intrinsic worth is excellent, it is the idea at the back of the scheme that makes its major appeal to us.

The Steelworks Association in Great Britain and the Office Technique pour l'Utilisation de l'Acier in France issue convincing literature as general propaganda for the increased use of steel. The excellent work done by the nickel, aluminium and tin industries is well known, and much appreciated in our own industries. Similar action by the ironfoundry industry as a whole has not yet been tackled in this country, but certainly it is a proposition well worth while careful consideration. The distribution of this American book to customers by British founders where personal relationship exists would be satisfactory, but obviously any wholesale release by federations or associations of foundry interests cannot for one moment be envisaged, as it would give the impression that the British foundry industry was somewhat static. Such is certainly not the case, but it needs two things:—(1) The assembly of scattered information not readily available and (2) an official blessing given to the claims it would contain. This American book runs into some 160 pages and is extremely comprehensive, yet there seems to be need for some additional matter, which would crystallise the outstanding features of the properties of cast iron in a few pages, one of which would make reference to the larger book. Whilst competition from weldings throughout Europe is decreasing, a proper intelligently-compiled book outlining the properties of cast iron would help to accelerate this pronounced tendency and to reinforce the general confidence which exists as to the reliability of cast iron.

## Art and Industry.

The recent appointment by the Government of a committee of industrialists in connection with art and industry focusses attention on a very old question as far as this country is concerned. There is no doubt that in comparison with European products as a whole British goods are often lacking from the artistic point of view. This is partly due to a conservative persistence in old designs, but is also undoubtedly due in part to what can only be described as a lack of artistic perception which the new movement may do something to repair. Those who went to the conference at Milan, for instance, could not fail to be impressed by the quality and quantity of artistic castings produced in Italy. The industry survives because there is a demand for such products. A very superficial examination of our statues, memorials, city plans, houses, and so forth suffices to show, firstly, that the same demand does not exist here, and secondly, that it is doubtful whether our artists could satisfy it if it did exist. Much of our artistic effort has gone into painting pictures to hang on walls when much of it could have been profitably devoted to giving form and colour to articles for everyday use which at present betray lack of imagination, even when they are not definitely in bad taste. The decorative aspect leads naturally to a consideration of the more fundamental aspect of this matter. It is not necessary that articles of utility should be decorative in the old sense (and we incline to the view that the day of purely decorative cast iron is gone), but it is important that they should possess that sense of form and that obvious fitness for function that in itself gives a sense of beauty quite apart from decoration. No one, for instance, would deny the real beauty of the spare and austere lines of the new Sydney bridge. Similarly, there is no reason why a domestic iron or a gas cooker should not impress the user in the same way. To this end, indeed, a good deal of progress has been made, but we should try to go further consciously and not feel after it blindly. The progress of the art and science of enamelling has enabled makers to add colour to form, and clearly there must be a public demand to explain the great growth in this direction. British engineers have an instinctive sense of this form, arising from fitness, as witness, for instance, the Royal Scot, compared with an American locomotive. If the new Committee can do anything to make this more conscious it will be a real help to industry.

XUM

## Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

### The Training of Foundrymen.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—The Paper by Mr. H. A. MacColl, B.Sc., must have interested the trade in general. It was of the greatest interest to me, as coming from a Graduate I was able to say a prayer of thanks that at last we are awaking to realism.

I most heartily agree with him that "City of Guilds Certificates," "National Certificates," and "Degrees" have failed, and lamentably so, but I do not think it is due to the causes he suggests, namely too many subjects, except, *in so far as the time allowed.* The syllabuses laid out for foundrywork and patternmaking by City and Guilds are undoubtedly good ones, but to properly accomplish the work the time should be at least eight years each when one considers that a typical year's course is 3 evenings a week of 2½ hrs. for 30 weeks, giving a total of 225 hrs., therefore in 8 years the total would be only 1,800 hrs., equalling about 40 actual working weeks, against 900 hrs. for certificate courses.

It makes one wonder who the people are that decide such questions. They most certainly lack a knowledge of practical work and sound judgment, and are undoubtedly committing inherent harm to industry and the future generation.

Mr. MacColl makes a reference to the lads failing to take interest, and from experience I would say that this is often due to a cause he recommends, namely one instructor taking the theoretical and another the practical. If one instructor takes both it is generally found that interest is greater, as he can co-ordinate his lecture with the practical work and solve many of the problems more easily.

When he states that "practical side of the foundry cannot be accomplished in a technical school," he only partially states the position. The actual is, I suggest, that only the fundamentals of practice can be given in the technical school. *Proficiency in the practice of any craft* can only be obtained in industry, and even in the case of apprentices trained in industry they must migrate from firm to firm if they are going to fit themselves for higher posts. Examinations will never do it. In concluding, may I say that the Paper is undoubtedly one of the broadest and soundest yet published, and it is to be hoped that authorities will hear the cry.—Yours, etc.,

CHAS. NORTHEY, M.I.B.F., A.M.I.Prod.E.
74, Nathans Road, North Wembley.
January 12, 1934.

[We are reasonably certain that Mr. MacColl did not decry either the City and Guilds Certificates or Degree Courses. Mr. Northey asks who are responsible for detailing the courses. The answer is to be found in the annual report published by the City and Guilds Institute, and an examination will show that the committee is composed of a well-balanced selection of practical men and educational experts.]

### Corner Effect.

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

Sir,—I note with interest, in your issue of December 21, that Frederick A. Melmoth, now an American colleague of mine, formerly a steel foundryman of your own country, rises to object mildly to the derogatory implication of the term "mass production," as used abroad in respect to castings made in America. As a reader of your JOURNAL for many years, I have observed this uncomplimentary and improper significance frequently given by our British friends. I am pleased to see that Mr. Melmoth, after exceptional opportunity for making comparisons, is attempting to clarify this matter for your readers.

I hope I may be pardoned for referring to two subjects in one letter. Another reason exists for my writing you, namely, your editorial on "Corners in Castings," in the same issue carrying Mr. Melmoth's comments mentioned above. Your discussion of the subject of corners necessarily was brief, omitting entirely mention of a factor which I think ought to be referred to, and which probably you appreciate in its full significance.

I have in mind the effect of the corner on a piece of highly-stressed metal, however the part may have been made. Admitting the inherent handicap of a corner in a casting, caused by the phenomena attending solidification in the mould, it should be kept in mind that any metal part, even when rolled or forged as a simple slab, will develop what in America we call a "stress-raiser," if machined in such a way as to form either an angle or a small radius at a member-junction, or appreciable change in cross-sectional dimension.

The effects of sharp corners, of small radii, and of large radii, in enabling a piece of steel to resist high stresses applied from directions and in ways to demonstrate potential strength or weakness, have been effectively described after careful investigation by prominent metallurgists in your own country and in America. Significant illustrations of the advantages of liberal radii are found in "The Fatigue of Metals," written by Professors H. F. Moore and J. B. Kommers. Incidentally, these American authors appropriately and generously dedicated their book to the many distinguished British investigators who have advanced our knowledge of the fatigue phenomena of metals.

Some of your readers may not realise the need for avoiding the sharp corner and the small radius in making an industrial part from any metal, by any method, if one wishes to preserve the inherent stress resistance of the material at the location concerned. The phenomena that occur when forming a metal part in its final shape in the sand mould undoubtedly add to the natural disadvantages of what we might call "cornering." But weakness at the abrupt junction is not an exclusive attribute of the casting.—Yours, etc.,

R. A. BULL.

541, Diversey Parkway, Chicago.
January 3, 1934.

## Publication Received.

**The Importance of Colloidal Graphite Lubricants on Running-in Operations.**—Issued by E. G. Acheson, Limited, 40, Wood Street, Westminster, S.W.1.

This bulletin contains a well-written article describing the rôle of colloidal graphite in "running in" machinery. It is couched in simple language and contains many practical hints and a description of the underlying principles. It is available to our readers on request, and we suggest that it is just the type of information worth acquiring.

(*Concluded from next column.*)

Happily the days when the closest secrecy was observed in the foundry trade are a matter of past history. We do not intend to conceal from foundrymen in this country the means whereby we have achieved such astonishing output figures. We have in fact secured the services of a leading publicity expert, and it will be his duty to acquaint the industry from time to time with the latest developments at the Gayway Foundry.

N. SNOOKERS.

## Random Shots.

### A REVUE OF INDUSTRY AT THE GAYWAY FOUNDRY IN 1933.

When the Editor towards the end of last year asked "Marksman" to approach Miss Nellie Snookers for a special article on "Industry at the Gayway Foundry in 1933," nothing would have given "Marksman" greater pleasure. For Miss Snookers was basking in sunshine at Monte Carlo at the time. But "Marksman" had barely the funds for a 3rd class ticket to Eastbourne, let alone to Monte Carlo, so he had perforce to wait until Miss Snookers returned to England. However, though too late for inclusion in the Editor's Annual Review Number, here is her article. As the cartoonist said when he read his own obituary notice in the newspapers, "better late than never."

* * *

In reviewing the fortunes of the Gayway Foundry in 1933 it is necessary first of all to refer to the conditions that arose that called for a clear-cut policy on the part of the management. The Gayway Foundry, in the past few years, has achieved an international reputation for the amazing originality of its research and experimental work. This side of its work has, in fact, always been considered as being of equal importance to ordinary production. Early in 1933 it was found that trade had improved to such an extent that to keep up with the demands made by our clients meant neglecting our development programme. This we were unwilling to do for several good reasons. For one thing, we believed ourselves to be on the verge of making a number of important discoveries which would revolutionise foundry practice. And whilst we had little fear of any other foundry forestalling us in the field of invention, we were anxious to complete our investigations for the benefit not only of the Gayway Foundry, but of the foundry industry internationally. A second reason was linked up with the improvement in trade. The management was confident that there would be a definite boom in business within the space of a few months. To secure the fullest advantage from this boom it would be necessary to have installed the most modern foundry plant and to be equipped with the very latest scientific knowledge. Unless we pursued our researches to a successful conclusion immediately, we would have to abandon them until the next trade depression.

* * *

We decided to do The Big Thing. We got in touch with our clients, and asked them whether, under the circumstances, they would be prepared to wait six months or so for the delivery of their work. With that unselfishness, that great-heartedness which is inherent in all buyers of castings, they recognised the gravity of the issues and expressed themselves willing to wait. There was, however, one dissenter, a world-famous astronomer. We were making some castings for a gigantic telescope which he had designed. With this telescope he wished to observe the total eclipse, in March, of the planet Emitevas—an eclipse which occurs only once in a hundred years, and which would be visible only through our client's instrument. The astronomer told us that, much as he wished our own researches success, he did not wish to defer his own scientific work for another hundred years.

* * *

We delivered his castings, and then abandoned ordinary production for six months. By July we had perfected new equipment, radically altered our foundry practice and carried the study of the metallurgy of metals to undreamed-of lengths. We were fully prepared for the biggest trade boom ever known to man. Production was in full swing by August, and since then our output has averaged ten tons of finished castings per sq. ft. of floor space per day.

(*Concluded in previous column.*)

# Developments in Foundry Refractories.*

By E. J. Crawley.

A casual observer may decide that refractories used in the foundry have made very little advancement during the last few years. Nevertheless, there are a few recent improvements and changes in principle worthy of consideration. This Paper has been divided into three parts: (1) Cupola linings, (2) the linings of crucible furnaces and (3) moulding sands.

### Cupola Linings.

In present practice, cupola linings may be generally divided into two classes; those built of specially-shaped firebricks and those rammed in

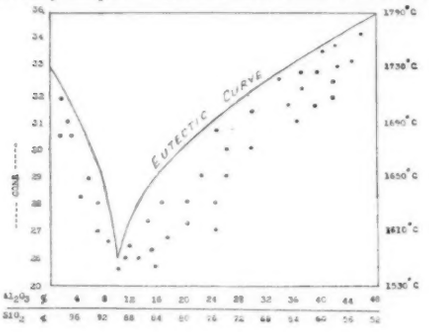



FIG. 1.—FUSION POINTS OF FIREBRICKS.

one piece with a monolithic refractory. There are very divided opinions as to the relative advantages of each method.

In order to examine the very many different types of cupola lining materials available from the point of view of chemical composition, in Fig. 1 is shown a graph kindly loaned by Mr. W. J. Rees, M.Sc., of Sheffield University. Almost without exception, cupola linings are composed, whether in the form of bricks or ramming materials, of fireclay substances, consisting of various proportions of alumina and silica in the form of aluminium silicates. The proportion of alumina to silica is an important factor and determines the behaviour of the refractory to an extent. Other influences, of course, such as iron oxide, lime and alkalies, also affect the refractory material's characteristics.

Supposing alumina and silica were mixed together intimately in various proportions, and the melting point of each trial mixture recorded, on a graph, the eutectic curve would appear as in Fig. 1. This takes into consideration alumina contents of 52 per cent. to 0 per cent. The eutectic point occurs with 10 per cent. alumina and 90 per cent. silica. The refractory values of a number of different types of firebrick have also been plotted and it is noticed they are slightly lower than the curve, due to fluxing impurities contained in the fireclay. Generally, they follow the direction of the curve. In the production of cupola linings the eutectic point is obviously one to avoid, and firebricks or ramming materials containing approximately 10 per cent. alumina have low refractory value.

Some foundrymen prefer the high-alumina bricks for their cupolas, and from Fig. 1 it would appear that they are superior. Nevertheless, better service is often obtained by lower-grade bricks with lower alumina content. Other factors, of course, such as the tendency of spalling with temperature fluctuations, slag resistance and mechanical strength at high temperatures, should be taken into consideration.

Rammed linings are largely siliceous, and for cupola work it is essential to keep the composition of this type of refractory material on either one side or the other of the eutectic point. An important characteristic of fireclays of chemical composition in the neighbourhood of the eutectic point is the ease with which a protective glaze is developed. This is a necessary consideration with rammed materials, which are generally lacking in mechanical strength as compared with bricks.

### Slag Resistance.

Theoretically one would expect that aluminous firebricks would most successfully withstand the action of molten iron-lime slag, owing to their more basic character. This is so to a certain extent, but bricks and ramming compositions with lower alumina seem to owe their slag resistance, as mentioned before, to their ability to glaze over.

The importance of proper jointing in the prevention of slag penetration cannot be overstressed. Ordinary fireclay joints have high shrinkage, and the voids left by this shrinkage after firing are very often the parts where slag first gains access. It is desirable to use a jointing material of which part has been pre-fired and so reduce shrinkage to a minimum. Preferably, a carefully-selected refractory cement which has even greater refractory value than the bricks should be used.

On Fig. 2 is shown the result of rather an elementary experiment of determining the slag resistance of a refractory cement to a high-iron slag. Two similar firebricks were used, one being covered with a $\frac{1}{8}$-in. coating of refractory cement. Powdered slag was then heaped on each brick and kept in place by a wall of cement. Both bricks were then heated to a temperature of 1,500 deg. C., which melted the slag to a very fluid state. Afterwards the bricks were broken and the extent of slag penetration could be examined. The slag penetration in the unprotected brick is considerable. Such a jointing cement successfully prevents slag penetration in the joints of a cupola lining.

Firebrick protected from slag by cement coating. | Coating of refractory cement. | Slag penetration in unprotected firebrick.

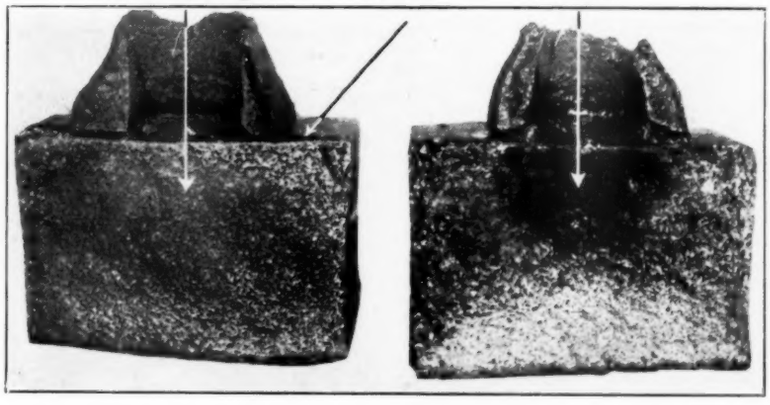


FIG. 2.—SHOWING SLAG-RESISTING PROPERTIES OF A REFRACTORY CEMENT.

### King's Earth.

Concerning monolithic linings for cupolas, a new development has followed the discovery in Northamptonshire of a rather remarkable type of clay. This clay is known as King's Earth, the deposit being near Kingscliffe.

King's Earth is from the same geological formation as Northamptonshire ganister clay, commonly used for cupola patching and lining. King's Earth is peculiar in its remarkable plasticity and bonding ability. When milled, this material develops into an unbelievably sticky mass. Its analysis shows it to contain approximately 85 per cent. silica and 7 per cent. alumina. With this composition it is on the alumina side of the eutectic point shown in Fig. 1. Its bonding ability enables it to be diluted considerably with silica in the form of silica sand, crushed ganister rock, old silica bricks and so forth. Sufficient may be added to make the chemical composition of the mixture well on the silica side of the eutectic point and with high refractory value. On the other hand, aluminous bricks may be mixed with it, raising its refractory value on the alumina side of the eutectic point. One of the outstanding features of such mixtures is the absence of shrinkage or permanent expansion when fired. Such mixtures may be used in the construction of monolithic cupola linings and patching materials produced, according to individual requirements. Another outstanding feature of King's Earth is the ease with which a protective glaze is developed.

### Patching Materials.

Generally, the subsequent cost of daily cupola repairs with ganister and similar compositions exceeds by far the original cost of the lining. Even closer attention should therefore be paid to the selection of suitable patching materials. Among other characteristics, a cupola patch must be plastic and workable. It must have minimum shrinkage when dried and fired, and must adhere to the brick lining and resist slag and abrasion of the descending charge.

As an alternative to repairing cupola linings day by day, a method now practised quite extensively is to increase the original diameter of the melting zone to allow for a rammed lining, several inches thick, to be installed. Such a lining is rammed behind shuttering-in sections or around a central core. A semi-dry refractory should be used, so as to minimise volume change, and considerable economy may be made by embedding old firebricks in the lining. In this way the brickwork behind gets little or no wear, and, finally, when the rammed part is worn, it is replaced. This method is adopted largely in foundries where the cupola is operated continuously. Fig. 3 is a photograph of a cupola hand putting the finishing touches to such a lining. In this particular foundry, old firebricks—of which there are always plenty—are used extensively. It is understood that the cupola-patching consumption is as low as 6 lbs. of patching per ton of metal melted.

### Basic and Neutral Cupola Linings.

Theoretically, one would expect that, as cupola slags are of a basic nature and are mostly responsible for the destruction of a lining, a basic

* A Paper read before the Burnley Branch of the Institute of British Foundrymen, Mr. F. Taylor presiding.

or neutral lining would be an advantage. Several experiments have been made in this direction without success. Magnesite, a definitely basic refractory, on account of its crystalline structure and high coefficient of expansion, has a serious tendency to spall with fluctuating temperatures, and on this account has proved unsatisfactory.

Of the neutral refractories, chromite also has had practical trial in a cupola. It would be expected that a refractory, which will withstand the basic fluxes and high temperatures of a basic

Fig. 3.—Finishing a Monolithic Liner in a Cupola.

open-hearth steel furnace, would likewise withstand cupola conditions. One practical trial recalled is that part of a cupola melting zone was constructed with chromite bricks. Although there was no evidence of spalling, the bricks disappeared almost completely during one "blow," seemingly having been "washed" away. A feasible explanation as to this behaviour, suggested that the reducing atmosphere of the cupola caused reduction of the iron compounds in the chromite to a "ferrous" state and with a corresponding lowering of refractoriness. The ferrous fluxes formed, having low viscosity, softened and liberated the more refractory particles of the brick, with the result that it disintegrated.

### Crucible Furnaces.

The modern tendency in furnace design and operation is to speed up the melting time. When this principle is applied to crucible furnaces, by employing more rapid heating and by using higher temperatures, the refractory lining has considerably more severe duty imposed upon it.

The well-known type of coke-fired pit furnace with natural draft, used for melting brass and gunmetal, etc., is usually lined with good-quality firebricks. Systematic repair with ganister prolongs the life of such a lining, sometimes for years.

The development of oil firing for crucible furnaces has presented fresh and serious problems to refractory manufacturers. In the first place, oil-firing gives a considerably higher local temperature, especially at that part of the lining where the flame impinges. At this point the brickwork is heated to a higher temperature than the remainder of the lining, which, unless it is sufficiently refractory, will soften and run. Also, the oil flame impinges at high velocity carrying molten ash. The ash of oil fuel invariably contains high proportions of alkalies, and these react with the free silica in the fireclay to form silicates with low melting points.

Oil-fired crucible furnaces working at high temperature, require a refractory which (1) has a higher fusion point than fireclay, and (2) does not react with the ash of oil fuel. Sillimanite is one of the refractories available which withstand these conditions. Sillimanite is a white crystalline mineral found in India, in the United States and also in Spain. It is composed mostly of alumina and silica ($Al_2O_3$, $SiO_2$). When heated and maintained at a temperature of 1,500 deg. C. it recrystallises into mullite in the form of long needle-like crystals ($3Al_2O3$, $SiO_2 = 3Al_2O_3$, $2SiO_2 + SiO_2$). In process of manufacture, raw sillimanite is heated to recrystallise it into mullite. It is then crushed up, graded, bonded and pressed into bricks. These bricks have a softening point of 1,800 deg. C. and they are especially resistant to alkaline slags. Very good service is being obtained by their use for both pulverisel fuel-fired and oil-fired furnaces.

Another factor to be taken into consideration in oil-fired furnaces is that the rapid heating of the lining tends to cause cracking and spalling of the bricks. Of the various well-known refractories, most fire-clay bricks resist spalling satisfactorily, being fairly elastic. Bricks like silica, chromite and magnesite are much more sensitive to sudden temperature changes, and unless treated with care spalling easily occurs.

### Magnesite Crucible Furnace Lining.

Magnesite is produced in various parts of the world, Austria, Greece and Canada especially. It is found in the form of a carbonate, and is subsequently reduced to the oxide by calcining and then hard burned at a temperature to stabilise and thoroughly shrink it. Magnesite bricks have a high refractory value, excellent resistance to basic slags, and they are hard and withstand abrasive forces at high temperature. As mentioned before, the weakness of magnesite brick is its tendency to spall. At present magnesite bricks are confined to furnaces where temperature does not fluctuate to any great extent, as in basic open-hearth steel furnaces. With the reduction of spalling tendency, no doubt their application could be widened considerably.

An effort has been made in applying magnesite for lining an oil-fired crucible furnace. The furnace in question had been adapted for melting a ferrous alloy, necessitating the use of a high temperature. Best-quality fireclay bricks were not sufficiently refractory for the purpose, and rammed siliceous compositions were also found to be unsuitable in the same respect. Finally, a trial was made with a magnesite lining.

A carefully-graded brick batch was prepared with an organic binder, and then rammed into specially-shaped blocks. These blocks were not fired in a kiln, but were built into the furnace in an unfired state. Fig. 4 is a photograph of

Fig. 4.—Unfired Magnesite Lining for Oil-Fired Crucible Furnaces.

the lining in question. In an unfired state, the face of the brick exposed to the flame became sintered to a hard mass. The remainder of the brick remained quite soft, and consequently was more elastic. In this way the spalling tendency was overcome and the magnesite itself resisted the high temperature, giving no sign of fusion. Some difficulty was found in minimising the after-contraction of the bricks on the surface, but this is being overcome. The use of magnesite has also been adapted to rammed linings of a similar nature, the material being moulded round a central core. It is believed that there is a considerable field for the use of magnesite for purposes such as the above.

### Refractory Concrete.

Still, in connection with crucible furnaces, a method of moulding large refractory shapes with a refractory concrete, instead of construction by firebricks, has been originated. Most plastic refractories need to be rammed into position. Instance may be taken of the various grades of ganister available and plastic firebrick compositions. Refractory concrete, however, is applied in a similar way to ordinary building concrete, being cast into position in the form of a mortar. With such a material, linings or special shapes

Fig. 5.—Moulding a Damper Block with Refractory Cement.

are poured behind shuttering or into a mould. Refractory concrete is applied to the construction of crucible furnace lids, damper blocks, door linings, etc. To make a furnace lid, for instance, an iron frame is laid on the floor and the refractory concrete strickled off. Without the application of heat, the material sets hard within 24 hours, even harder than burnt firebrick and without any sign of shrinkage. Fig. 5 is a photograph of a damper block being moulded in this way. Not only does this process take less time than building with firebrick, but the finished article is jointless and stronger and more durable.

### Moulding Sands.

Turning from furnace refractories used in the foundry, an even wider field of refractories is available in moulding sands. The cheapest and most abundant refractory available is sand. All sand cannot be described as moulding sand, the term usually being applied to sand containing various proportions of clay bond. Nevertheless, since the development and now almost universal use of artificial core binders, high-silica sands, free from clay matter, now come also under the heading of moulding sands.

Ironfoundries in this country are fortunate in having within easy reach unlimited supplies of moulding and silica sands of every type. The facilities for obtaining natural and good moulding sands cheaply, have made it unnecessary to make use of synthetic moulding sands to any great extent. In the United States synthetic sands are used with success in many foundries. In comparing the use of natural moulding sand and an artificial mixture of silica sand with a clay bond, the natural sand has in its favour:—(1) Natural distribution of the bond is invariably better than an artificial process; (2) cheapness, as more often than not a natural sand is produced more economically than the synthetic equivalent; and (3) the characteristics of the bonding clay in a natural moulding sand are generally superior to clays available for making synthetic sands.

Synthetic sands have an advantage in that almost perfect standardisation may be made with the sand mixture in respect of the amount of bond used. Also, reclaiming of synthetic sand is simplified in the fact that only one bond is used.

Undoubtedly, the most important factor determining the success of a synthetic sand lies

(*Concluded on page 77.*)

# The Addition of Non-Ferrous Metals to Cast Iron.

By J. E. Hurst (Vice-President of the Institute of British Foundrymen).

(*Concluded from page* 28.)

### Molybdenum Cast Irons.

The element molybdenum has attained a position of considerable importance in ferrous metallurgy, and whilst interest in the effect of its addition to cast iron alloys has been very great, it is only natural that its commercial development in this direction should be somewhat slower on account of its high cost. The addition of small percentages of molybdenum does undoubtedly lead to increased tensile strength. Whilst this property is of value in certain directions, the future use of molybdenum would appear to depend upon its ability to reduce the effect of mass, or, in other words, to produce greater uniformity in properties throughout a given section.

Considerable attention has been given to the addition of this element to cast iron roll mixtures, particularly in America. It is claimed for such rolls that they are stronger, there is less breakage in service, greater resistance to wear, less frequent dressing, and a smoother and better finish to the rolled products. A typical composition of a molybdenum cast iron chilled roll is given as follows:—Total carbon, 2.96; silicon, 0.60; manganese, 0.27; sulphur, 0.06; phosphorus, 0.34, and molybdenum, 0.28 per cent.

The joint additions of chromium and molybdenum to roll metal have been made the subject of a recent British patent application. The preferred composition is given as follows:—Total carbon, 3.00-3.75; silicon, over 0.75; manganese, 0.20-0.80; phosphorus, under 0.10; chromium, 0.90 to 1.25, and molybdenum, 0.15 to 0.80 per cent.

Exceptionally high additions of chromium and molybdenum have been recorded for cast-iron rolls. Such a composition is given below:—Total carbon, 1.4; silicon, 0.7 to 1.0; manganese, 0.3; sulphur, 0.04; phosphorus, 0.03; chromium, 12.00, and molybdenum, 1.00 per cent.

The joint addition of nickel and molybdenum and also chromium and molybdenum is resorted to in special cases. Piwowarsky, in his investigations, considers a combination of vanadium with tungsten or molybdenum as giving an alloy cast iron not without promise. Molybdenum cast irons can be made having air-hardening properties, and additions of molybdenum are being made for this purpose.

A malleable cast iron under the name Moly Iron is recorded as being used in America for the manufacture of brake drums. This material contains 2 per cent. carbon and 1.75 per cent. silicon and is subjected to an 8-hr. anneal. To obtain higher Brinell hardness 0.25 per cent. molybdenum is added to the base mixture. Another variation of this is the addition of suitable amounts of copper and manganese to the base mixture.

### Aluminium Cast Irons.

It is probable that the most important commercial use of aluminium additions to cast iron is in the preparation of the aluminium-chromium alloy cast irons suitable for nitrogen-hardening. Aluminium additions either alone or in conjunction with chromium are of great interest on account of their influence in improving the heat-resisting properties of ferrous materials. The commercial development of alloys of this type is confronted with many difficulties. These have been met by attempts to treat the cast articles by various types of surface-coating processes, of which aluminising is typical. In these processes aluminium and/or chromium is incorporated by various means in the surfaces of the particular articles.

### Vanadium and Titanium.

It is probable that revived interest in both these elements as additions to cast iron is to be ascribed in part to the development of certain pig-irons which contain varying quantities of these elements. These pig-irons, of Norwegian origin, contain vanadium and titanium in varying amounts up to approximately 0.75 per cent. of each. Beneficial properties of a general character are claimed to be associated with irons containing these percentages, and mainly in this manner these elements are used as additions to cast iron. The addition of titanium in percentages of 2.25 to 3.75 per cent. to chilled-roll mixtures is stated to produce rolls chilled independently of their being cast in sand or metal moulds. The use of vanadium in conjunction with chromium, titanium being present also, can be adopted for the production of an excellent alloy cast iron suitable for hardening and tempering

### Alloy Cast Irons for Hardening and Tempering.

A most important development in the application of non-ferrous alloy additions to cast iron is in the production of alloy cast irons suitable for hardening by processes of hardening and tempering exactly as in the case of steels. As is well known, there are many engineering

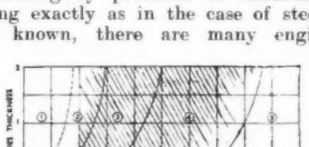



FIG. 6.—INFLUENCE OF NICKEL IN THE STRUCTURAL CHARACTERISTICS OF CAST IRON.

applications where materials are required in the hard condition, and, until the discovery of the facility of hardening and tempering cast iron, it was only possible to produce such parts in cast iron, initially hard in the "as-cast" condition. The facility for hardening and tempering cast iron is obviously invaluable, as it permits preliminary machining operations of an involved and intricate character being carried out on the material in the soft condition "as-cast," and hardening can be carried out subsequently by the heat-treatment operations of quenching and tempering. This development of due primarily to modern research work wherein it has been shown very clearly that throughout such heat-treatment neither the strength properties nor brittleness of the cast iron is impaired, but in the case of suitable compositions and with suitable treatments, the strength properties are actually improved. In the oil-quenched condition the hardness is raised to approximately 500 Brinell and the ultimate strength lowered considerably. In this condition the material is weak and fragile, and it is only after subsequent tempering that the strength of the material is restored. In this particular instance, at a temperature of tempering of 350 deg. C., the ultimate strength is raised to a value substantially in excess of that of the material in its original "as-cast" condition. With this treatment, the hardness is lowered slightly with increasing tempering temperatures. As in the case of steels, the material in the quenched condition shows a strongly martensitic structure, as shown in the photomicrographs. Tempering is, of course, accompanied by a gradual decomposition of the martensite in the usual manner.

In suitable thin sections, most plain unalloyed cast iron is capable of being hardened by oil quenching from suitable temperatures. In a like manner, plain chromium, copper, aluminium-chromium, molybdenum and vanadium with or without chromium, when alloyed with cast iron, have the effect of improving the hardening properties, and the presence of nickel is not a *sine-qua-non* in alloy cast irons for hardening purposes. Nickel is, however, a useful constituent in such irons, in that it lowers the critical speed of quenching and has a very marked effect in increasing the depth of penetration of the hardening effect in thicker sections of material. The effect of thickness of section is of great importance and must be taken into consideration in fixing the most suitable alloy composition for a given type of casting intended for hardening purposes. A few typical compositions of alloy cast irons used in the production of hardened and tempered cylinder liners are summarised in the following table:—

| No. | T. C. | C.C. | Si. | Mn. | P. | Ni. | Cr. | Cu. |
|---|---|---|---|---|---|---|---|---|
| 1 | 3.0–3.4 | 0.6–0.75 | 1.9–2.4 | 0.75–1.00 | 0.4–0.75 | Nil | 0.25–0.75 | Nil |
| 2 | 3.0–3.4 | 0.6–0.75 | 1.9–2.4 | 0.75–1.00 | 0.4–0.75 | 0.5–0.75 | 0.25–0.75 | ,, |
| 3 | 3.0–3.4 | 0.6–0.75 | 1.9–2.4 | 0.75–1.00 | 0.4–0.75 | 0.25–0.5 | 0.25–0.75 | 0.25–0.5 |

The effect of nickel in increasing the critical speed of quenching is of importance in relation to considerations of thickness, and it will be appreciated that in certain circumstances it is possible to have too much nickel present when quenching will tend towards the retention of the austenitic condition, with a consequent lack of hardening effect. With sufficient nickel present it is sufficient to allow the alloy cast iron to cool down in air to obtain the air-hardening effect. Such air-hardening alloy cast irons are produced commercially, and a typical range of compositions are described in British Patent No. 342,335 (Picken):—Total carbon 2.70 to 3.50, Si 1.00 to 3.00, S 0.14 max., P 1.00 max., Mn 0.50 to 1.50, Ni 3.00 to 6.00 and Cr 1.50 to 2.00 per cent.

### Alloy Cast Irons Suitable for Nitrogen Hardening.

As indicated already, the alloy cast irons developed for nitrogen-hardening purposes contain essentially the non-ferrous elements aluminium and chromium. Typical compositions and properties have been described by the writer (J.I.S.I. No. 1, 1932), and an example is given below:—Total carbon 2.65, silicon 2.58, Manganese 0.61, phosphorus 0.096, aluminium 1.43 and chromium 1.69 per cent.

Castings in this alloy can be surface hardened by heating in anhydrous-ammonia gas at a temperature of 500 deg. C. The surface hardness developed by this treatment is from 900 to 1,100, measured by the Firth diamond-hardness tester, and the depth of penetration with a treatment of 80 hrs. is from 0.015 to 0.030 in.

Alloy cast irons of this type in the nitrogen-hardened condition are being used extensively for cylinder liners, and are produced and sold in this country by the firm with which the author is connected under the Trade Mark "Centrard." Other general castings are being produced also, and the super-hard surfaces are found to have numerous applications under conditions where resistance to wear is required.

### Martensitic Cast Irons.

The addition of increasing amounts of nickel to cast iron is accompanied by an increase in hardness, and in ordinary commercial sections of from ½ in. to 1 in. thickness the maximum hardness is obtained with nickel additions of between 5 and 6 per cent. The structure of such nickel-hardened cast irons is martensitic, and hence the use of the phrase "martensitic cast irons" in their description. The diagram,

Fig. 6, illustrates the approximate influence of nickel additions on the structural characteristics of cast iron of average composition. The hardness of such martensitic cast irons is in the neighbourhood of 400, and whilst this is not so easily machined as ordinary cast iron, modern machine tools and cutting tools are able to machine such irons economically. The joint addition of nickel with chromium can be used for the production of such castings, and in this case the amount of nickel can be lowered.

The use of alloy additions to white irons or chilled irons has been referred to on several occasions in this Paper, particularly in reference to the use of alloys in the production of rolls. The hardness and also the strength properties of white irons can be increased by alloy additions, and many such are used for this purpose. The joint addition of nickel and chromium, or molybdenum and chromium, for this purpose are the most usual methods adopted, and in many of these cases the strength properties are increased by as much as 100 per cent., in addition to a substantial increase in the intrinsic hardness. The development of these alloys has already resulted in the production of materials which are likely to prove formidable rivals to

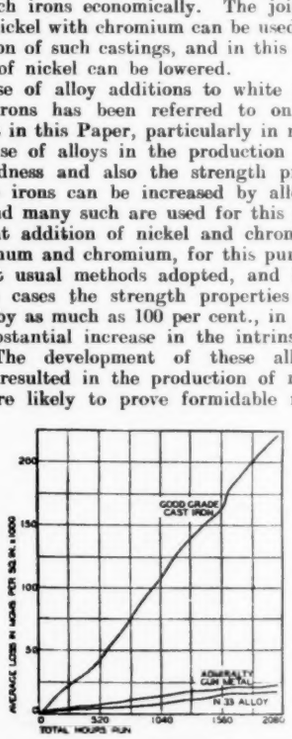



FIG. 7.—CORROSION-RESISTING PROPERTIES OF CAST IRON, ADMIRALTY GUNMETAL AND AUSTENITIC CAST IRON.

many of the special steels hitherto used for this purpose.

### Austenitic Cast Irons.

A number of elements and combinations of elements when added to iron-carbon alloys have the effect of preserving the austenitic condition at normal temperatures. Two examples of the commoner elements which have this effect are nickel and manganese. The diagram, Fig. 6, may be used to illustrate the effect of simple additions of nickel to a normal cast iron from which it will be observed that with simple additions of nickel of over 15 per cent. the structural condition of the cast iron at normal temperatures assumes the austenitic character. As in the case of ordinary cast irons, the austenite is accompanied by the presence of graphite and possibly carbides. The presence of increasing amounts of carbides is visible in the three structures shown. In commercial austenitic cast irons the phosphorus constituents may be present also, depending upon the actual composition of the material, and naturally the properties are modified somewhat by the presence of these extraneous constituents, and substantial variations in the properties can be provided for by modification in the chemical composition.

Three of the most important of the commercial austenitic cast irons are known as No-Mag, Ni-Resist and Nicrosilal. No-Mag is probably the earliest example of the commercial application of such cast irons and was developed by Mr. S. E. Dawson, of Messrs. Ferranti (British Patent No. 204,508). The essential feature of these alloys is the presence of nickel and manganese. A typical composition contains 10 per cent. nickel and 5 per cent. manganese. Some nickel may be replaced by copper, and the presence of aluminium is recommended also. A composition containing copper is as follows:—Nickel, 5; copper, 5; manganese, 5, and aluminium, 1 per cent.

Ni-Resist is a nickel-copper-chromium austenitic cast iron and is manufactured commercially with slight variations in composition under a variety of names such as Nimol, Hypocrode, No. 7 Alloy, etc. Typical compositions of these alloy cast irons lie within the following limits:—Total carbon, 2.8 to 3.1; Si, 1.3 to 1.7; Mn, 0.75 to 1.25; P, 0.10 to 0.5; Ni, 12.5 to 14.5; Cu, 5.0 to 7.0, and Cr, 2.5 to 6.0 per cent.

TABLE III.—*General Properties of Austenitic Cast Irons compared with Cast Iron and Non-Ferrous Alloys.*

| | Austenitic cast iron. | Ordinary cast iron. | Brass. | Bronze. |
|---|---|---|---|---|
| Specific gravity | 7.5–7.6 | 6.9–7.7 | 8.0–8.2 | 8.2 8.5 |
| Specific heat, 0 deg. to 100 deg. C. | — | 0.12 | 0.09 | — |
| Thermal conductivity | 0.08 | 0.11–0.13 | 0.26 | 0.26 |
| Magnetic permeability maximum | 1.03 | 240.0 | 1.0 | 1.0 |
| Specific resistance, microhms per c.m.³ | 150.0 | 95.0 | 7.0 | 16.9 |
| Resistance temperature coefficient, 0 deg. to 100 deg. C. | 0.00045 | 0.0019 | 0.002 | 0.00865 |
| Coefficient of expansion | $1.8 \times 10^{-5}$ | $1.1 \times 10^{-5}$ | $1.88–1.98 \times 10^{-5}$ | $1.8 \times 10^{-5}$ |
| Tensile strength | 15–25 | 12–20 | 20–40 | 20 tons per sq. in. approx. |
| Elongation | 1–3 per cent. | Nil | 20 per cent. | 8 per cent. |
| Mod. of elasticity, lbs. per sq. in. $\times 10^6$ | 14–21 | 14–18 | 11–14 | 1–141 |

Nicrosilal is a recent development in this field and is a nickel-silicon-chromium cast iron, the invention of the British Cast Iron Research Association (British Patent No. 378,508). The composition of Nicrosilal is approximately as follows:—Total carbon, 1.75; silicon, 5 to 6; nickel, 18.0; chromium, 1.5 to 5; and manganese, up to 1.0 per cent.

The general properties of the austenitic cast irons are quite distinctive. The true austenitic cast irons are generally non-magnetic or feebly magnetic of medium strength and Brinell hardness. They generally possess a low elastic limit and high deformability. They are susceptible to work hardening and do not harden on quenching. Certain compositions can be temper hardened or are susceptible to precipitation hardening. Another feature of great importance in these alloys is their high coefficient of expansion and their low thermal conductivity. Table III summarises the approximate values of the principal general properties of austenitic cast irons in comparison with those of ordinary cast iron and the common non-ferrous alloys, brass and bronze. The comparison with brass and bronze has been drawn deliberately with a view to emphasising a very important aspect of these new cast-iron alloys. In many respects they closely resemble these common non-ferrous alloys. For example, some of the austenitic cast irons have remarkable resistance to corrosion, and their behaviour in this respect very closely resembles that of the bronzes, as is revealed by the results given in the following table and illustration (Fig. 7). This resemblance has led to a study of the commercial application of austenitic cast irons to the production of decorative metal castings. There are those who believe that the public taste in colour of decorative metal work is undergoing a change away from the yellow metals in the direction of the more steely colours, and, if this is the case, it is possible that, through these newly-discovered austenitic cast irons, the iron-foundry may regain the important position it used to possess in the supply of decorative metal fittings. As examples of the progress made already, the author is able to include a series of illustrations of the work of the famous Italian foundry of Vanzetti, of Milan, through the kindness of his friend, Dr. Guido Vanzetti. These (Fig. 8) illustrate quite a wide range of decorative products in the austenitic cast iron, Ni-Resist.

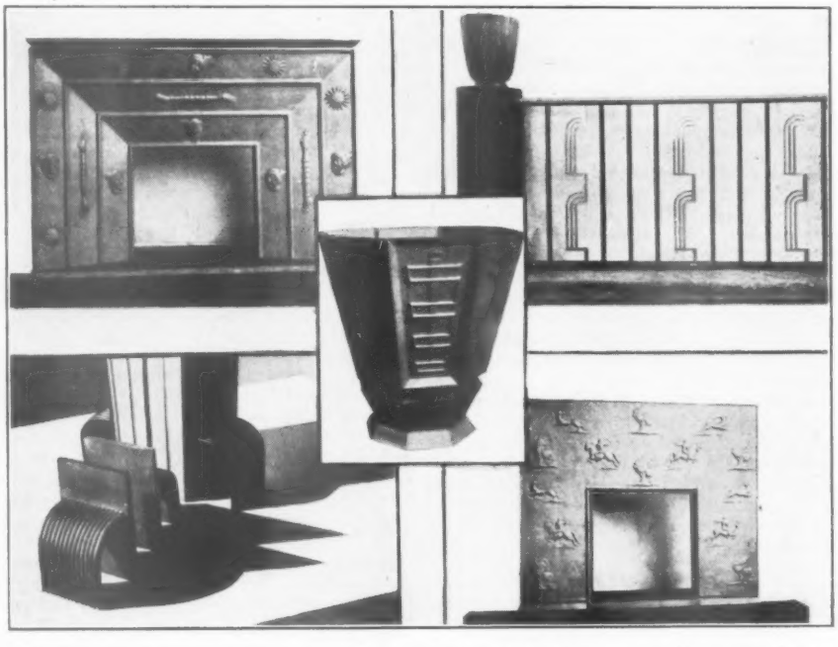


FIG. 8.—ART CASTINGS CARRIED OUT IN AUSTENITIC CAST IRON BY THE VANZETTI (MILAN) STEEL FOUNDRY COMPANY.

The potential decorative value of the austenitic cast irons is by no means the most important, as these alloys find extensive use already in the electrical trades on account of the non-magnetism and high resistivity. The

corrosion-resisting properties render these alloys of great value in many sections of the engineering and chemical industries. Another outstanding application lies in their use for parts called upon to resist erosion, and suitable compositions of austenitic cast irons have met with considerable success in the production of pump castings for this purpose. The austenitic cast irons show marked superiority over ordinary cast iron at elevated temperatures and have a high resistance to scaling and growth. Nicrosilal was developed originally for heat-resisting purposes.

**Summary.**

The author has attempted to cover the field of the addition of non-ferrous metals to cast iron as it is practised commercially to-day. The position of this field in the year 1928 has been described at the commencement of these notes; to-day the ironfoundry is able to offer the engineer:—

(*a*) High-quality grey cast irons, containing nickel and/or chromium and molybdenum possessing improved characteristics of strength uniformity and soundness.

(*b*) High-strength grey cast irons, containing nickel and/or chromium and molybdenum, possessing exceptionally high-mechanical strength properties, together with uniformity of structure and properties.

(*c*) Hard white cast irons, containing nickel and/or chromium and molybdenum, capable of yielding high-hardness values, coupled with improved mechanical strength properties.

(*d*) Hard martensitic cast irons, containing nickel and/or chromium, having high Brinell hardness values, together with good mechanical properties and possessing a graphitic structure.

(*e*) Oil- and air-hardening cast irons capable of yielding high-hardness values, coupled with high-strength values, by heat-treatment at convenient stages in the machining processes. These irons generally contain nickel and/or chromium molybdenum.

(*f*) Nitrogen-hardening cast irons capable of being surface hardened by the nitrogen-hardening process and containing essentially the elements aluminium and chromium.

(*g*) Chromium-alloy cast irons having excellent heat-resisting properties.

(*h*) Austenitic cast irons, containing nickel and/or copper, manganese, silicon and chromium, possessing properties of high-electrical resistivity, non-magnetic, high coefficient of expansion, corrosion- and heat-resisting properties, with moderate ductility and high-strength values.

The list cannot be closed without reference to the high-silicon acid-resisting cast iron and the high-silicon heat-resisting cast iron known as Silal, both of which are silicon-alloy cast irons containing more than the normal percentages of silicon.

Finally, the author wishes to record his thanks to the Bureau of Information on Nickel for permission to use various illustration from their literature, and to the directors of Messrs. Sheepbridge Stokes Centrifugal Castings Company, Limited, for information and data placed at his disposal.

### Magnetic Susceptibility in Metals and Alloys.

In a Paper in the Science Reports of the Tôhuku Imperial University, Y. SHIMIZU points out that, notwithstanding many investigations hitherto made, the effect of internal stress or cold-working on the magnetic susceptibility of metals and alloys has not yet been completely solved. An investigation was undertaken by the author to obtain a further knowledge on the same subject, and the following results were obtained:—With an increasing degree of internal stress, the paramagnetic susceptibility of metals and alloys decreases, while their diamagnetic susceptibility numerically increases. In the case of an alloy of gold with platinum, its susceptibility is changed by cold-working from paramagnetic to diamagnetic. A theory is proposed, by which the experimental results obtained can be satisfactorily explained in a quantitative way.

## Design and the Foundry.

By T. R. HARRIS.

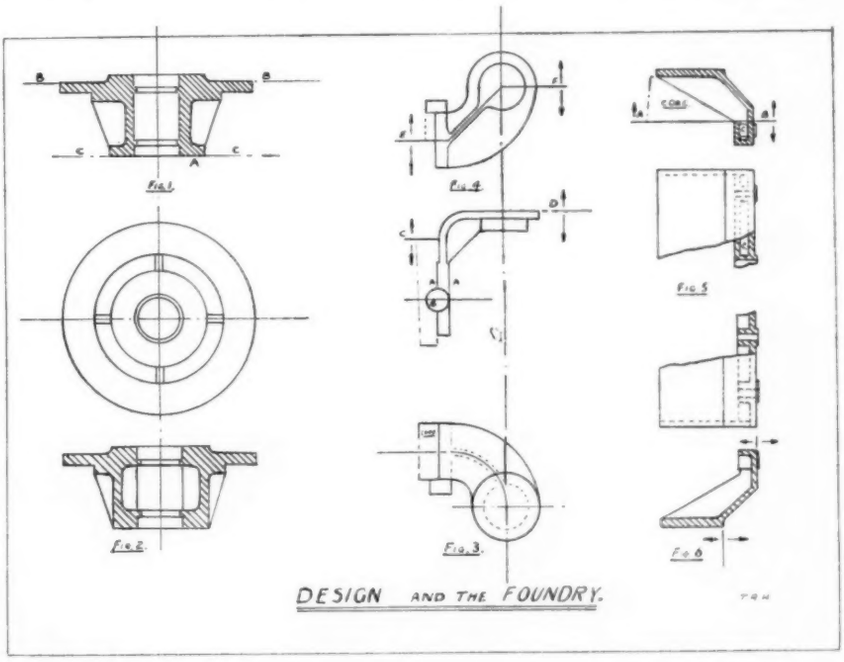
The subject of the most suitable design of a casting is one that cannot receive too much consideration from a foundryman's point of view. There are designers who produce on paper what to them is the perfect design as regards strength and general utility, yet from the foundry viewpoint is a very bad design. Many examples can be called to mind of thick and thin sections in juxtaposition which would have been sources of weakness had not the design been modified. Whilst bearing these examples in mind the following notes deal with design from a different point of view. It is not so much from the considerations regarding strength as cost of manufacture that these examples are chosen.

Many designers, after making rough sketches of the castings required, submit them to the foundry authorities for their opinion before finally settling the design. Where this is done many pounds can be saved, for only on very rare occasions is a design so rigid that modifications cannot be arranged. Certain manufactures consist of a number of various makers' units assembled together, i.e., a portable air-compressing set would consist of an air compressor, an engine for either petrol or crude oil, a radiator, etc. When assembling it may be found necessary to replace certain castings by others of different dimensions, and the following examples deal with this class of job. In each case the casting supplied had to be replaced by one made in the works foundry. The original design was followed in each instance with the necessary dimensional adjustments until pointed out by the foundry that by a simple alteration the cost of production could be considerably reduced.

Fig. 1 shows a common type of wheel hub, and needing a three-part box for its manufacture, because of the flange A, joints having to be taken in the mould at BB, CC. The cap which fits flange A is kept on by studs; heads of bolts are not required under flange A. It was, therefore, suggested that, since a core had to be used for the bore, if the body was enlarged to the size of the flange, the core could also be increased, as Fig. 2, which makes a straightforward moulding job. This was just as strong as Fig. 1, because it was suitably ribbed up, and also was made for considerably less cost.

Fig. 3 shows a bracket of rather peculiar shape, which, if made as drawn, needed a core to enable facing pieces A and boss B to be extracted from the mould. This also needs a joint along line CD, and was a very awkward casting to make. Fig. 4 shows the amended design which substituted a straight rib for the curved one and enabled the pattern to be split along line EF. Two aluminium patterns and a joint board enabled these castings to be produced more economically, beside being a neater and cleaner job.

Fig. 5 shows an engine foot which needed a core to take out a portion of the job. The dotted line shows the core print and joint of mould is at AB. As can be seen, this was a very awkward core to make, and also very delicate along ridge C. Fig. 6 shows the design ultimately decided on, which keeps the essential points of the original, but avoids the use of a costly core. Also, by making two patterns and a joint board, these now can be made on a moulding machine at a fraction of their previous cost. It is by a careful watching of the design of castings that a considerable saving in production costs may be obtained, as the above examples illustrate.




### Weldless and Lapwelded Boiler Tubes.

Following the issue in July, 1933, of the cold-drawn weldless-steel boiler and superheater-tube Specification (B.S.S. No. 494), the British Standards Institution have now issued the following further Specifications for boiler and superheater tubes:—Hot-finished weldless-steel boiler and superheater tubes for steam temperatures not exceeding 850 deg. Fah. (B.S.S. No. 512); lapwelded wrought-iron boiler tubes for external pressure (B.S.S. No. 527), and lapwelded-steel boiler tubes for external pressure (B.S.S. No. 528). These Specifications complete the general series of British Standard Specifications for boiler and superheater tubes which have been prepared as part of the work undertaken two years ago in connection with land boilers. The Specification for hot-finished weldless-steel tubes provides for tubes for designed steam temperatures up to 750 deg. Fah. and for temperatures between that and 850 deg. Fah. For the latter range an additional requirement is included, that the steel used in the manufacture of the tubes shall be of the non-segregated or fully-killed type. The Specifications for lapwelded tubes are for external pressure only. The Land Boilers Technical Committee is now turning its attention to the preparation of British Standard Specifications for fittings, and a draft is in the course of preparation for safety valves. Copies of these Specifications can be obtained from the Publications Department, British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d. each post free.

XUM

# Steels in Marine Engineering Service.

## MODERN REQUIREMENTS AND SPECIFICATIONS.

At a meeting of the Institute of Marine Engineers, held in London on January 9, Mr. S. N. Kent in the chair, MR. T. H. BURNHAM* read a Paper on "Steels in Marine Engineering," in the course of which he considered the requirements of steam propulsion and oil-engine propulsion, and then referred to the conditions attending various components, and made suggestions regarding suitable types of steel. We append abstracts concerning some of these steels.

### Steam Valves.

Valve bodies are usually made of ordinary carbon-steel castings or forgings, the smaller valves as drop forgings. For use with steam at high temperatures and pressures a molybdenum steel or a chromium-molybdenum steel (C 0.3, Cr 1/1.5, Mo 0.8) having enhanced resistance to creep has been employed. In the cast condition carbon steel is roughly no better and no worse as regards creep strength than in the forged condition, and as far as can be traced the same holds good for low molybdenum steel. Some valve makers do not admit the necessity of an alloy-steel valve body as the designs are so strong that the stresses in the wall are small, and it may be said that for the bulk of current needs ordinary steel is satisfactory and economical, but for high steam temperatures alloy steel eliminates thick and heavy designs.

Most makers use some type of stainless steel for the spindles and a high nickel-copper-tin alloy for the seats, though some engineers employ a corrosion-resisting steel valve seat also. The non-corroding steels generally used belong to one of the three following classes: (1) High chromium, 12/14 per cent. or 18 per cent., the latter being more resistant to electrolytic corrosion; (2) 18/8 chromium-nickel steels; (3) 35/12 rickel-chromium steels. Of course the same material should not be used working on itself, as picking up or seizure may result. Some trouble has in the past been experienced in the attack of spindles by packing materials, but the austenitic types of corrosion-resisting steels have proved highly resistant. Recently, nitrarded steel has come into service for valve components, *e.g.*, gate-valve seatings, as it is more resistant to corrosion than ordinary steel, and its high superficial hardness which does not fall off up to 500 deg. C. enables it to resist wear and abrasion.

### Turbine Requirements.

As regards the steels used in turbine construction they may be considered under four headings: (1) Blading; (2) wheels or discs; (3) casings; (4) shafts.

*Turbine Blading.*—The steels employed for turbine blading include 5-per cent. nickel, 13-per cent. chromium, and 35/12-per cent. nickel-chromium steels.

*Turbine Casings.*—Severe temperature strains through the structure may produce distortion of casings, and with the raising of the temperature and pressure of the inlet steam steel has replaced cast iron for temperatures above 450 deg. Fah. Ordinary carbon steel (C 0.3, Si 0.6, Mn 0.8) has so far proved adequate up to temperatures of 760 deg. Fah., but for higher temperatures 0.50-per cent. molybdenum steel has been employed. In the heat-treated condition the latter has a high yield point, is tough, and its creep limit at elevated temperatures is considerably above that of ordinary steel. Yield point 21-27 tons, max. stress 32-38 tons, elong. 21-17 per cent., impact test 7 (kgm./cm.$^2$).

### Cylinder Covers and Cylinder Liners.

Whilst cast-iron cylinder covers (16 to 18 tons tensile) are still used, cast-steel covers are also now employed, *e.g.*, in submarines and special engines where light weight is important. Although steel is more susceptible to heat stresses, which are 2 to 2½ times those in cast iron for a given temperature, the permissible reduction in thickness may practically eliminate this disadvantage.

Attempts to produce welded-steel cylinder covers have not been successful, but reference may be made to the method of brazing together cast bodies and forged-steel combustion plates developed by Dr. Sass. The process is carried out with CuNiZn or spelter (melting point 1,150 deg. C.), in an atmosphere of hydrogen at 1,200 deg. C., and the mechanical strength of joints is reported to be stronger than the parent metal. This method, which has been in use for five years, has been applied in making both 2-stroke and 4-stroke cylinder covers.

Considerable attention has been given to liner materials, as liner wear constitutes an important part of Diesel engine repair bills.

Unfortunately experts are not in agreement as to the cause of liner wear, viz., whether it is due to abrasion, direct corrosion by products of partial combustion, defective combustion, inefficient lubrication or other causes, such as the quality of fuel burned. In a recent research it was established that the wear of cylinders was less if the walls were kept hot. In oil engines the difference between starting and running is not however so high as in automobiles.

Cast iron is still widely used, and in several makers' experience a close-grained cast iron has given at least as good results as the special irons, whether containing titanium, vanadium, molybdenum or nickel and chromium. Forged-steel liners are being used by some makers on account of resistance to the effects of temperature and abrasion. They are usually of 0.6/0.7-per cent. carbon steel treated to give 60/70-tons tensile.

### Exhaust Valves.

The essential properties of valve steels have been exhaustively studied in connection with petrol engine construction. They may be briefly recapitulated as follows: Freedom from scaling and pitting, strength at high temperatures, high notched-bar value at working temperatures, freedom from forging cracks, absence of residual strains, no change in physical properties due to running conditions, absence of intercrystalline brittleness and boundary deposition of carbides, resistance to corrosion fatigue at high temperatures, and good wear resistance. Not much trouble is experienced with exhaust valves in 4-stroke Diesels, but heat-resisting steels are frequently used either as separate heads or for the complete valve with stem.

The heat-resisting alloys used are generally of the following types, silicon-chromium steel, nickel-chromium-tungsten steel or high nickel-chromium alloy, depending on the size and speed. Although these valve materials are more expensive than cast irons they not only maintain efficient running but reduce running costs by keeping replacements at a minimum. Reduced valve spindles may be built-up with a hard-wearing metal, *e.g.*, electric-arc deposit of manganese steel or other abrasion-resisting steel or Stellite, or by Fescolising. Nitrided valve stems help to prevent scoring and pick up. Valve seats have to withstand hot exhaust gases at high velocity and the hammering action of the valve. Cast iron has frequently given good service, but seats of heat-resisting steel which are non-shrinking under heat or of metals like Stellite are preferable for resisting severe conditions and helping to prevent distortion.

### Pistons and Gudgeon Pins.

Although aluminium alloys are widely used for piston construction, especially with steel liners, hollow-steel forgings have been used by some builders (28 to 32 ton or 32 to 35 ton Siemens-Martin steel).

Dead-annealed carbon-steel cast pistons have given the following tests:—Yield point 17-20, max. stress 35-41, elong. 18-12. Cast copper-chromium-molybdenum steel pistons for high-speed Diesel engines show a high yield point:—Yield point 25, max. stress 38-44, elong. 18.

Forged steel pistons not only save weight but their diminished wall thickness reduces stressing by the fluctuating heat transferences. Moreover, their coefficient of expansion is less than that of aluminium alloys.

Gudgeon pins play an important part in the inaccessible position where they are frequently secured by means of contraction, but may be of the fully-floating type. They are generally made of case-hardened steel—straight carbon, nickel or nickel-chromium steel. Air or oil-hardening nickel-chromium steel is also used. Nitralloy gudgeon pins have also been used with satisfaction.

Ordinary medium carbon steel (0.2 to 0.4 per cent.) of 34 to 38 tons tensile or nickel steel is mostly used for shafts, and here again it is suggested that design is equally or more important than material. Some engineers contend that it does not matter whether the cranks are twisted or not, but if the revolution is against the line of twist the drive tends to untwist them, and it appears better to forge the cranks solid to the required angle. The distance between the crank webs should be 50 per cent. greater than the diameter. Shafts of uniform flexibility give no concentration of stress, and bearings should be truly aligned and not too long.

## N.I.E.F. Annual Meeting.

The National Ironfounding Employers' Federation, which comprises a number of District Associations of Ironfounders engaged in the production of heavy castings (as distinct from the light-castings industry), held its annual meeting at 49, Wellington Street, London, on January 4, when the following office bearers were appointed:—

*President*: Mr. James Smith (South Shields).

*Vice-Presidents*: Nominated by the District Association.

*Secretary*: Mr. Harold Judd, C.B.E., C.A.

*Hon. Treasurer*: Mr. A. E. Cadman (Manchester).

Sympathetic reference was made to the death of Mr. J. A. S. Hassal, who had acted as secretary of the Federation since its inception.

The vacancy in the secretaryship was filled by the appointment of Messrs. Mann, Judd, Gordon & Company, Chartered Accountants, of 8, Frederick's Place, London, E.C., who have acted as secretaries of the Scottish Ironfounders' Association and the North of England Ironfounders' Association for a number of years.

Mr. Harold G. Judd, C.B.E., C.A., of that firm, took an active part in the formation of those Associations before the war, and it may be recalled that during the war he occupied an important position in the Ministry of Munitions, latterly as Deputy Controller of Contracts, where his duties brought him into contact with practically all branches of the iron and steel industry.

The Federation has in contemplation certain important developments which should greatly strengthen its position and redound to the benefit of its members in particular as well as of the industry as a whole.

THE ENGLISH ELECTRIC COMPANY, LIMITED, have recently received orders for two Diesel-engined alternator sets, one for installation at Ilfracombe and the other for Australia.

# New Electromagnetic Vibrating Screens for Alternating Current Supply.

The demand for a vibratory screen that can be plugged into any alternating-current supply and requires minimum attention during operation, can now be met by the new a.c. Sherwen screen, developed after exhaustive and lengthy experiments on a great variety of material at the Fraser & Chalmers Engineering Works of The General Electric Company, Limited, Erith, Kent. The efficiency and sound design of the new screen have been proved under the most arduous conditions, and in addition to incorporating all the best features of the original Sherwen screen, it has the advantage that a motor-generator set is not required.

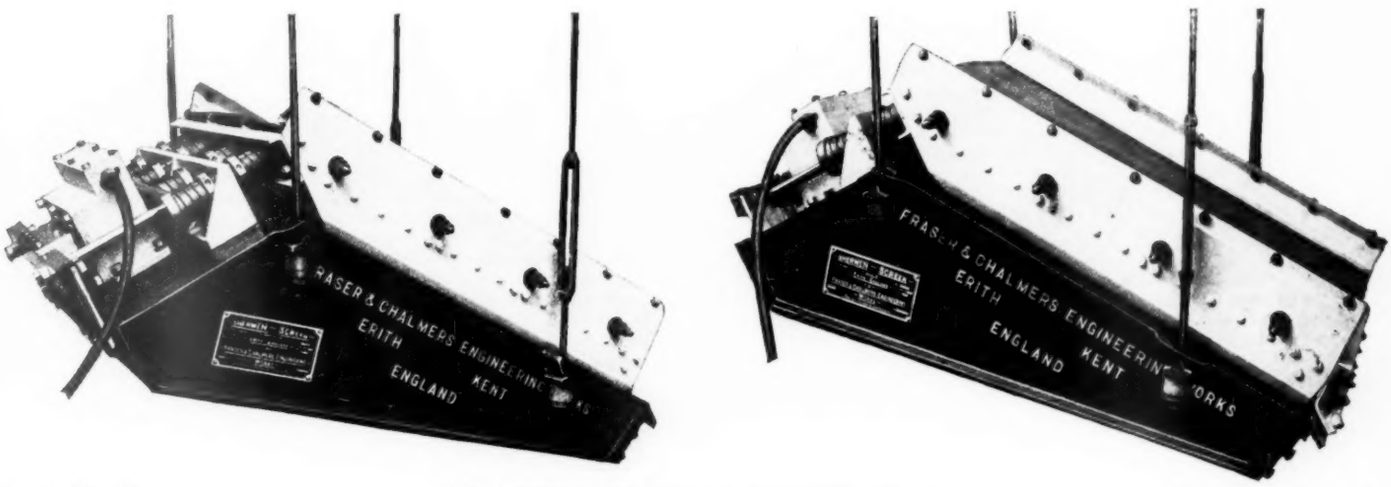
The principle of operation is extremely simple. The contact gear used on the old type of screen is eliminated, and the vibrations are obtained by the use of a Westinghouse half-wave metal rectifier connected in series with the vibrator coils. The cycle of operations begins with the rectified half-wave from the rectifier passing to the vibrator coils and drawing forward the armature, which is connected to the screen frame. During the other half-wave of the a.c. cycle, the current is prevented from passing to the coils, thus enabling the springs supporting the armature and live-screen frame to accomplish the return stroke. A 50-cycle a.c. supply transmits to the live screen frame an intense vibration of 3,000 cycles per min.

The Westinghouse metal rectifier used is definitely trouble-free. No difference in its conditions is ascertainable after many years of continuous use, and it has thus a distinct advantage over the motor generator, particularly under the dusty conditions met with in many industries.

As with the original Sherwen screen, the vibrating unit is fixed at the back of the screen frame, away from the screen cloth. With the new screen, however, advantage has been taken of this position to give the most intense vibration to the cloth at the feed end. It will, of course, be appreciated that at the feed end a quick separation of the material is beneficial, as it enables the bulk of the undersize material to be taken out, leaving the lower part of the screen free to deal with the more difficult problem of the particles near to aperture size. The gradual decrease in vibration towards the discharge end also has the effect of restraining any material small enough to pass through the screen aperture from bouncing down the screen when freed from the fines. A great deal of experimental work has been carried out on this problem of vibration, with the result that the variation in vibration introduced in the new type of screen definitely ensures the maximum efficiency.

The intensity of vibration is easily controlled, and adjustment can be made to the angle of the screen and the vibration intensity while the screen is in operation. Little supervision is necessary. The moving parts are entirely spring-supported so that no lubrication is needed, and repairs and replacements are reduced to a minimum.

The a.c. Sherwen screen is made in standard sizes from 3 ft. by 5 ft. to 4 ft. by 8 ft., with either single or double decks. The power consumption is exceptionally low, and the high capacity and efficiency of the screen have been maintained on the most difficult screening propositions. Loss of vibration is minimised, as the screen is suspended and insulated from the supporting structure by rubber buffers.




(LEFT) FEED END. THE SHERWEN ELECTROMAGNETIC VIBRATING SCREEN. (RIGHT) DISCHARGE END.

Since receiving the above, we have inspected the Sherwen screen in operation in the foundries of Messrs. Fraser & Chalmers, Limited, and our observations will be printed in a future issue.

### Fusion of Grey Cast Iron.

Conclusions regarding the mechanism of fusion of cast iron are drawn by F. VANIS in "Chimie et Industrie" from the micrographic examination of suitable samples which are heated for a short time to just below the melting point and then quenched. It is found that just below the melting point there is a rapid dissolution of the carbon which lowers the melting point and causes the fusion of the metal between the graphite lamellæ. A high content of phosphorus accelerates the dissolution of the carbon, while silica has the reverse effect.

### Capacities and Properties of Steel Tubes.

Messrs. Stewarts and Lloyds, Limited, have issued a supplement to their tables of capacities and properties of steel tubes in the usual format and bound in a special cover. Following two sections of notes on the flow of water in steel pipes and on tables of the discharge of water mains, are the actual tables, which are applicable only to new and clean pipes, for coated pipes, slope 1 in 5 to 1 in 800, and 1 in 850 to 1 in 6,000; and bitumen-lined pipes, slope 1 in 5 to 1 in 800, and 1 in 850 to 1 in 6,000. These tables are reproduced on stout paper and bound with linen, making them suitable for frequent use without damage in the engineer's office and workshop.

## Developments in Foundry Refractories.

(*Concluded from page 72.*)

in the selection of the bonding clay. Such a clay should have the following properties:—(1) It should be sufficiently refractory so as not to soften unduly during the casting process; (2) it should have good plasticity and bonding ability so that only small additions are necessary; (3) it should be present in a proportion which will not impede the escape of gases from the mould; (4) when used for dry-sand work, it should dry to a hard mass on stoving; (5) it should strip easily from the casting; and (6) it should retain its colloidal properties when dried to a fairly high temperature in order that it may be used over and over again.

### Synthetic Iron-Moulding Sands.

Some success has been attained in the production of synthetic iron-moulding sands from the raw materials available in the Pickering sand quarries, Yorkshire. Here several fine-grained sands are available from a weak, almost bondless material to well-bonded grades. Efforts were made to utilise the weak grade of sand by making a synthetic mixture with a clay. Many experimental attempts of mixing and milling it with proportions of various types of fireclays were unsatisfactory, mostly because the clays tried would not spread sufficiently well and the mixtures were inclined to dry in a friable state.

Then, by chance, attention was drawn to the clay-like condition of the land in one part where the sand bogies passed. Investigations showed the existence of a deep bed of what first appeared to be clay, brown in colour, and evidently containing a proportion of colloidal ferric oxide. Actually, it was a fine-grained moulding sand, consisting of a high proportion of bond clay, in the neighbourhood of 30 per cent. When this proportion is compared with the average clay grade of a moulding sand (about 7 per cent.), the consistency of this material will be appreciated. Its bonding ability is high, having more than four times the clay grade of ordinary moulding sand.

Experiments in using this bond for synthetic mixtures are in progress. This development has reached a stage when a 42-ton cast-iron bedplate has been successfully cast in this synthetic mixture.

The instances given show the possibilities of utilising synthetic sand in this country, providing the right type of clay bond is selected. The Pickering material described indicates that such clays are available in this country, and there are probably several more elsewhere, waiting to be exploited.

XUM

# Foundry Selling Practice.

## REPLACEMENTS AND GUARANTEES.

**By Eric N. Simons.**

One of the bitterest problems with which the foundry has to wrestle is that of replacements. It is virtually an unwritten law that a good foundry stands behind its products to the full. In practice this means that if a customer complains and proves that the castings are defective in any way, repair or replacement is undertaken without charge, on condition that the faulty goods are returned. But there are a large number of border-line cases, of which an example or two may be given.

Welding is frequently a source of difficulties in this respect, particularly in the steel-foundry industry. Assuming that a number of castings have been supplied to a customer, and on examination, perhaps after certain machining operations have been carried out, a slight flaw is discovered, a flaw not necessarily affecting the integral strength of the piece, but demanding treatment of some kind. Usually, the use of arc welding will remedy the trouble to the complete satisfaction of both customer and user, where these are different. But ever and again there crops up some idiosyncratic person who disbelieves, with a disbelief amounting almost to fanaticism, in the ability of welding to repair the trouble, and who insists on a replace casting.

It is often in vain for the founder to weld up the casting, and, by the words of experts and test sheets galore, endeavour to convince the customer that the casting is now completely suitable for the purpose. Nothing but a replacement will satisfy. What is the founder to do? Refuse to replace, and make an enemy; or stick to self-interest, and meekly obey?

Then over this matter of machining there is another difficulty that arises from time to time. A casting is supplied, and a certain amount of machining done upon it. Eventually, defects are discovered, laid bare after the cutting tool has removed the outer surface of the piece. Complaint is made, and the founder agrees to replace the casting. But the customer is not satisfied with this. He argues that he has put a certain amount of time, labour and expense, all of which are wasted, into a defective piece of material, and he demands that this amount shall be repaid. Here, again, is a dilemma for the founder. Is he to put up a fight, or yield easily, and lay up a store of future trouble for himself?

### Second-hand Castings.

Another interesting case occurred recently, and raises points of no small importance. A steel foundry shortly after the war supplied a large number of stock replace parts for certain machines to a large firm in the north. Eventually, this latter firm decayed and disappeared, and its works, including the whole stock of replace castings, was sold at bargain prices. A certain scrap merchant bought up the replace parts for a song because they were standard for a popular type of machine; and eventually sold them to a user at a price yielding him a considerable margin of profit. When these parts were delivered, a number of them were found to be defective. They were returned to the seller, who, by the cast marks on the pieces, knew the foundry that had made them. He promptly wrote claiming replacement from the foundry.

The foundry could not trace ever having supplied him with castings, sent a representative to investigate the matter, and ultimately ascertained the facts. Here, once more, a tricky problem arose. Was the foundry to repudiate the claim, or was it to stand through thick and thin by its own products and replace them just as if they had been supplied to a legitimate customer?

To quote yet one more example of these thorny matters, a number of castings of a brittle character were supplied to a large customer, who eventually returned a large percentage of them, claiming that they had cracked. Investigation proved that they had been sound when delivered, and it was argued by the foundry that they must have received improper handling at the user's works. This was, of course, indignantly denied, and the imputation was that, owing to some defect internally, the castings had cracked spontaneously. Was the foundry, on the authority of its experts, to call the customer a liar, or to replace without demur?

### How the Difficulties were Solved.

From their own experience, most foundries will be able to match these incidents. But the point at issue in this article is whether or not it is possible to deduce certain basic principles for their handling. To show how greatly notions differ on the subject, it may be mentioned that in a case of rejected welding repairs, the founder replaced. In the second instance quoted, the founder refused to pay for machining losses. In the third example, the defective castings were replaced. In the fourth, replacement was refused, and a year later the customer discovered careless handling by weighbridge men as the cause of the trouble.

If anything emerges, then, it is that every case must be taken on its merits; but it would hardly be worth a whole article merely to enunciate that, if only because taking a thing on its merits depends on who is the taker. The merits of a case will appear different to A from their appearance to B, and the decision will be accordingly. It is worth while, then, to make some attempt to formulate a few principles. Even the Yankee maxim, "The customer is always right," will not prove a golden rule, because quite often the customer is wrong, and knows it. Even a well-known watch company had to abandon free replacement, for the reason that people formed a wrong impression. Instead of saying, "Fine people; they always stand behind their goods!" what they were actually saying was, "They know the watches are rotten; that's why they always replace them, to stop the talk." And there was also a large percentage of folk simply out to "do them down."

### Guarantees.

But it is mental laziness to assume there are no safe principles. The first rule postulated is this. Never give a written or printed guarantee that you are not prepared to stand by, but let that guarantee be "vetted" by a lawyer before you give it. Let someone who knows tell you just what is and is not implied in that guarantee. It is useless coming along to a customer eventually and saying, "Yes, but that guarantee does not mean just that; it means this." If the wording of a firm's guarantee is such that it can be read to mean something different from its own interpretation of it, it has been badly drawn up, and the firm should not expect the customer to pay for its looseness of terminology.

On the other hand, if a replacement offer or guarantee has been carefully, clearly, and understandingly worded, so that it means exactly what it says, and implies no subtle reservations, then the customer should be called upon to stand to it, and it should be no excuse for him to say he thought it meant something else, or that he did not read it, or that John Jones, from whom he has bought in the past, never had such an arrangement with him. If the customer is a man' a firm cannot afford to antagonise, an element of expediency will, inevitably, creep into one's attitude; but such instances should be reduced to a minimum, for the report of a weakening, or the hint that a guarantee can be evaded, spreads and weakens the guarantee itself.

Examination of the typical form of quotation employed by many foundries suggests that it has been inherited rather than constructively drawn up. The founder of the firm, in all his be-whiskered Victorian glory, probably scribbled it out on a bit of scrap-paper after a cursory glance at a few typical specimens of his own date. These terms of quotation need bringing up to date and legally revising. It is difficult to see, for example, why a foundry employing welding should not indicate clearly that castings will not be replaced unless a satisfactory weld is impossible, but that if the casting fail in use after welding, replacement will be made. Any dispute as to the satisfactoriness or otherwise of a hypothetical weld could be submitted to quick and inexpensive arbitration, an independent arbitrator being named.

It is equally difficult to see why replacement should not be confined, in writing on acceptance of orders to the actual purchaser only, if this is the policy of the firm. It is difficult, in short, to see why contingencies that arise almost weekly should not be effectively guarded against in this way. It can be said without hesitation that firms are continually, though they do not know it, issuing, with every quotation or order-acceptance, guarantees whose legal implications would stagger them, if they were set down. It does not follow that because ordinary business practice seldom leads to a thorough-going interpretation of these clauses, such an interpretation is impossible. Therefore, it should be prevented.

### Carriage on Defectives.

The question of carriage often arises in connection with guarantees, simply because care has not been taken to specify what is intended. If the founder refuses to pay the carriage cost of returning defective goods to himself, he should clearly say so. If he does pay this cost, he should again indicate the fact. Whatever conditions or limits his offer should be mentioned. Nothing should be left to "gentlemen's agreements."

Finally, in the carrying out of replacement and guarantee policy, the founder should be as consistent as is humanly possible, not only because his customers will know how far to press him, and how far it is possible to take advantage of him; but, also, because his own staff will more clearly understand what to do when these instances of defective material arise, and will be less likely to let their individual temperaments influence their actions. It should always be *the policy of the foundry* that is put into practice in these cases, *not* the whim of the individual. And the final golden rule is that no procedure should be too rigidly applied. There should always be at least one hole in the net to let a big fish go through; but it is the fish's job to find it.

## Accident Prevention in the Building Trade.

The National Employers' Mutual General Insurance Association, Limited, of 10, St. Mary Axe, London, E.C.3, has prepared a 200-page booklet on this subject, which they are selling at a nominal price of sixpence. Much of the information is applicable to foundry work. For instance, we noticed an illustration of a wheelbarrow with a guard for the men's hands. This notion is well worth following in the case of men taking their barrows between stacks of pig-iron or relatively narrow aisles. Another notion taken at random—"Machinery or material should not be placed close to the edge of an excavation" is one that has application within our own industry. We could find a hundred or more similar cases, and with this in mind we recommend our readers to invest the necessary sixpence. It may save pounds in workmen's compensation.

# This Week's News in Brief.

## Trade Talk.

THE VULCAN FOUNDRY, LIMITED, has received an order from the Bombay, Baroda & Central India Railway for five locomotive boilers.

SIR WILLIAM ARROL & COMPANY, LIMITED, have started work on the removal of the Universal steel-mill plant from Clydesdale to Corby.

MESSRS. STEWARTS AND LLOYDS, LIMITED, are to issue £2,000,000 of 4 per cent. debenture stock, the whole of which will be placed privately.

A NEW SUBMARINE for the British Navy was launched from the Barrow shipyard of Messrs. Vickers-Armstrongs, Limited, recently.

THE GLASGOW CORPORATION WATER DEPARTMENT have ordered 286 tons of cast-iron pipes from a Middlesbrough foundry at a cost of £2,199.

THE ANNUAL MEETING of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on Thursday and Friday, May 31 and June 1.

A REFLEX OF THE SITUATION in the iron and steel trade of the West of Scotland is provided at Glasgow Harbour. A number of cargoes of iron ore are on the way, including a third shipment of about 8,500 tons from the new source of ore supply at Sierra Leone and a large cargo of Spanish ore.

NON-CORROSIVE STEEL is rapidly making its way into the home for purposes of both utility and decoration, and it will be the setting for some of the chief displays at the "Daily Mail" Ideal Home Exhibition, to be held at Olympia from April 3 to 28, of which "Staybrite City" will be a feature.

AT THE WORKS of the Midland Iron Company, Limited, Rotherham, recently, Mr. George Baker, President of the Rotherham Chamber of Commerce, set in motion a 500-h.p. motor to drive the forge mill. The 8-in., 9-in., 10-in. and 16-in. mills were electrified a few years ago, and this completes the electrification of the rolling mills.

THE ADMIRALTY have decided to entrust the construction of the destroyers of the 1933 programme to the following firms:—Fairfield Shipbuilding & Engineering Company, Limited, Glasgow; Alexander Stephen & Sons, Limited, Glasgow; John I. Thornycroft & Company, Limited, Southampton; Vickers-Armstrongs, Limited, Barrow-in-Furness. Each firm will build two vessels.

THE FIRST LAUNCH on the Clyde this year took place from the yard of the Fairfield Shipbuilding & Engineering Company, Limited, on January 16, when the new L.M.S. paddle steamer "Mercury," built for service on the Firth of Clyde, was put into the water. The vessel has an overall length of 229 ft. 7 in., moulded breadth 30 ft., and a displacement of 712 tons, with passenger accommodation of 1,350. She has a cruiser stern and covered paddles.

THE WEST OF SCOTLAND heavy-iron industry is to take combined action to secure the use of steel in the construction of the proposed new Glasgow bridge over the River Clyde at Finnieston. The estimated cost of the bridge is £1,200,000, of which £400,000 has been expended on the provision and preparation of sites. The coal, iron and steel industries claim that more employment will be given to the West of Scotland if steel is used in preference to ferro-concrete.

ARBROATH DEAN OF GUILD COURT passed plans last week for an extension of the iron foundry of James Keith & Blackman Company, Limited, engineers and ironfounders, Arbroath. The extension embraces part of the buildings of former flax mills, Stanley Works, recently acquired by the firm. In these premises, between Abbey Street and Stanley Street and Abbey Street and Abbot Street, the plans provide for a new foundry, approximately 246 ft. by 58 ft.

FURTHER CONTRIBUTIONS to infirmaries and charitable institutions have been made from Scottish firms' benevolent funds, as follow:—The employees of Messrs. Lane & Girvan, Caledonia Foundry, Bonnybridge, £141 14s.; Messrs. William Dixon & Company, Limited, Govan and Calder Iron Works, brickworks and colliery, £529 16s. 7d.; Messrs. Harland & Wolff, Limited, Glasgow works, £344; the Grangemouth Dockyard Company, Limited, Grangemouth, £101 7s.

MESSRS. STERNOL, LIMITED, the well-known oil and lubricant manufacturers, Finsbury Square, London, have decided considerably to increase the area of their works and to instal new up-to-date machinery for handling the numerous products that they manufacture. The Research Department lays itself out to meet the requirements of manufacturers for any process oils, fats or compounds that may be useful to them in the course of their business, and a special laboratory is devoted entirely to this work.

A FURTHER LARGE SHIPMENT of iron and steel work for Russia has been loaded at Glasgow this week. The cargo comprised steel plates, rails and tubes manufactured by Messrs. Colvilles, Limited, the Steel Company of Scotland, Limited, and Messrs. Stewarts and Lloyds, Limited, equal to about 5,500 tons, which was loaded into the Russian motorship "Dvinolse." The firms are hoping that further orders will shortly be received from Russia, but much will depend upon the result of the negotiations now in progress with a view to a new trade agreement with Russia.

THE MIRRLEES WATSON COMPANY, LIMITED, Scotland Street, Glasgow, has taken over the small steam-turbine business previously carried on by Messrs. Scott & Hodgson, Limited, Guide Bridge, Manchester. The complete designs, drawings, technical data, patterns and special tools have been purchased by the new owners, and they have also engaged the services of Mr. R. P. Turney, who has had charge of this section of Messrs. Scott & Hodgson's business for the past six years. The turbines are of the impulse type, and are manufactured as either radial or axial flow in sizes from ¼ h.p. to 400 h.p., which may be direct coupled to pumps, fans, blowers, exhausters, compressors and electric generators.

## Contracts Open.

**Ely,** January 29.—48 tons of 3-in. spigot and socket iron water pipes, with specials, for the Urban District Council. Mr. A. E. Woodrow, clerk, Urban Council Offices, Lynn Road, Ely.

**Egypt,** February 14.—1,380 metres of 48-in. and 3,440 metres of 36-in. cast-iron pipes and accessories, 16 manhole covers and frames, 850 step irons, etc., for the Egyptian Ministry of Public Works. The Department of Overseas Trade. (Reference G.Y. 13,318.)

**Simla,** January 29.—(1) 26 tons aluminium; (2) 435 tons lead, pig; (3) 215 tons copper, electrolytic; (4) 103 tons copper, standard; (5) 30½ tons nickel; (6) 51,200 (number) tinned plates, coke finish, for the Indian Army. The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 5s. each schedule.)

## New Companies.

**R. W. Munro, Limited.**—Capital £5,000. Ironfounders and mechanical engineers. Subscriber: M. Gumpright, 12, Mount Pleasant Mansions, Upper Clapton, London, E.5.

**Metalion, Limited,** Friar House, 39-41, New Broad Street, London, E.C.2.—Capital £10,000. Electrochemical engineers. Directors: J. A. R. Clark, A. W. H. Hay, R. J. Fletcher and R. E. Binns.

### Four Large Bells Repaired.

Until a few years ago the repair of large church bells was considered impossible, the only alternatives when they cracked or developed serious faults being to re-cast them or to send them to the local museum. Now, however, the repair of bells by welding is becoming a common occurrence. The most recent accomplishment of Barimar, Limited, of 14-18, Lamb's Conduit Street, London, W.C.1, who pioneered bell repair by welding, is the reconditioning of four very beautiful old inscribed bells from the church of St. Mary, Woodbridge, Suffolk. They weighed 26½ cwt., 17½ cwt., 12½ cwt. and 9¼ cwt. respectively, and dated from 1799, when they were cast by Thomas Osborn, of Downham Market. In each case there were extensive cracks in the crown due to the rusting and consequent expansion of the iron clapper staple. After repair the bells were sent to Messrs. Gillett & Johnston, of Croydon, for any retuning that might be necessary, but it was found that none was needed.

## Personal.

ON SATURDAY EVENING, January 20, Mr. George Pate, O.B.E., J.P., general manager of Carron Company, was entertained by his staff and presented with a gold watch in recognition of his 21 years' service as manager.

MR. VINCENT C. FAULKNER, Editor of THE FOUNDRY TRADE JOURNAL, Past-President of the Institute of British Foundrymen and of the Foundry Equipment and Supplies Association, has been elected a member of the Executive Council of the National Ironfounding Employers' Federation.

## Obituary.

MR. FRANCIS JACKSON, manager of Messrs. N. F. Ramsay & Company, Limited, brassfounders and lock makers, Charlotte Square, Newcastle, died recently.

MR. JOHN WALLACE, blacksmith, Ayr, has died at his home in his 88th year. He was in the employ of Mr. William Paterson for a period of over 63 years, and was working until his 80th birthday.

LORD ABERCONWAY died on Tuesday at the age of 83. He was chairman of Palmers Shipbuilding & Iron Company, Limited, the Tredegar Iron & Coal Company, Limited, and the Sheepbridge Coal & Iron Company, Limited.

THE DEATH of Mr. Robert Wastling, aged 95, of Beverley, last week, recalls the days of Beverley's once famous foundry, which was the mainstay of the town's industrial life for many decades during last century, but the site of which has now for a long time been occupied by a railway goods depôt and the Cottage Hospital. The works, of whose activities the late Mr. Wastling was probably the only survivor, closed down in the early 'eighties.

MISS PEGGY FRAME, aged 22, the fifth daughter of Mr. David Frame, who is the chairman and managing director of Hammond Lane Foundry, Limited, Dublin, was killed in a tragic accident recently. Miss Frame was riding a horse on the main road near Delgany, Co. Wicklow, when the animal shied at a motor-lorry. Miss Frame was thrown on the ground and the wheels of the lorry passed over her head. Death is believed to have been instantaneous.

THE DEATH HAS OCCURRED at his home in Bo'ness of Mr. Malcolm Naismith at the age of 86 years. Mr. Naismith was for 70 years in the employment of Grange Foundry, Bo'ness, and retired only four years ago. He was known hardly to have lost a day due to illness. He was responsible for the turning out of a large amount of important work from Grange Foundry, including the ornamental railing for Rangoon Post Office and the decorative railing on the Thames Embankment.

## Company Reports.

**Steel Company of Canada, Limited.**—Quarterly dividend of 30 cents on the common stock.

**Steel Developments, Limited.**—Net profit, £4,524; brought in, £4,436; dividend of 6 per cent., tax free; carried forward, £4,466.

## Applications to Register Trade Marks.

The following list of applications to register trade marks is extracted from the "Trade Marks Journal":—

"GARTSHERRIE."—Pig-iron. William Baird & Company, Limited, 168, West George Street, Glasgow, C.2. (Continuous user claimed.)

"AXIGLIDE."—Centrifugal pumps. Harland Engineering Company, Limited, B.E.P. Works, Longcarse, Alloa, Scotland.

"GALVAMATT."—Unwrought and partly-wrought metals. Baldwins, Limited, Baldwin House, Great Trinity Lane, London, E.C.4.

"EGLINTON."—Pig-iron. William Baird & Company, Limited, 168, West George Street, Glasgow, C.2. (Continuous user claimed.)

"ITZOR."—Conveying machines, mixing machines and automatic stoking machines. Richard Sizer, Limited, Cornwall Street, Wilmington, Hull.

*Applications to the Cutlers' Company, Sheffield.*

STAYBLAD.—Unwrought and partly-wrought metals. Thos. Firth & John Brown, Limited, Atlas and Norfolk Works, Savile Street, Sheffield.

XUM

# Raw Material Markets.

The extent of the improvement in the iron and steel trades is shown by the fact that steel output last month totalled 669,000 tons, as compared with 430,000 tons a year ago, while the monthly output of iron is now above 400,000 tons. Twelve months ago pig-iron production only totalled about 285,000 tons. In spite of this, there is still a large unsatisfied demand, and further steps are being taken to increase output.

## Pig-Iron.

**MIDDLESBROUGH.**—There continues to be a strong demand for local iron in the home markets, and the output is being considerably expanded. Two additional furnaces are already producing iron, one is being started now, two are to come into operation next month, and two more as soon as they can be got ready. There is a strong probability of an early rise in quotations. The nominal home price of No. 3 Cleveland G.M.B. pig-iron is 62s. 6d. per ton delivered Middlesbrough, 64s. 6d. delivered North-East Coast, 62s. 3d. delivered Falkirk, 65s. 3d. delivered Glasgow. No. 1 Cleveland foundry iron is 2s. 6d. per ton more and No. 4 foundry and No. 4 forge iron 1s. per ton less than the foregoing prices.

The producers of East Coast hematite, already heavily booked, are adopting a reserved attitude with regard to forward business. There continues to be a strong demand, but it is difficult to get supplies at the current quotation of 62s. 6d. per ton for mixed numbers, f.o.t. makers' works. Merchants are awaiting a rise in the market, and the makers have little or no current iron to sell.

**LANCASHIRE.**—Many consumers of pig-iron in this area have already contracted for supplies for the next two or three months, but there has, nevertheless, been an additional number of forward orders on the market during the past week or so, largely arising from fears of an impending increase in quotations. The call for iron against contracts has been very satisfactory this month. Midlands brands of iron—Derbyshire and Staffordshire—and North-East Coast No. 3 are all quoted for delivery to users in the Manchester district on the basis of 67s. per ton, with Northants at 65s. 6d., Derbyshire forge at 62s., East Coast hematite at 76s. 6d., and West Coast at 80s. 6d. With regard to Scottish makes, the undertone is somewhat firmer than it has been of late, and there is less disposition among merchants to shade prices. Offers of this iron are in the region of 80s. per ton, delivered to Manchester works.

**MIDLANDS.**—The market is very firm. The outstanding feature continues to be the strong demand for iron for the light-castings makers. The Northamptonshire furnaces are virtually off the market at present quotations, but the Derbyshire makers have still some stock in hand to work off. The Association figures, which include delivery to Birmingham and Black Country stations, remain at 62s. 6d. per ton for Northants No. 3 and 66s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, less rebate to large consumers. In connection with special irons, the demand is improving slightly, owing to the fact that the engineering trade shows signs of expansion. So far prices have undergone no change; they vary considerably according to tonnage and the point of despatch, railway charges being a considerable factor. Medium-phosphorus pig is quoted between 70s. and 80s., Scottish 85s., and other low-phosphorus iron from 80s. to 85s., whilst refined irons are quoted from £5 15s. to £6 15s. per ton delivered.

**SCOTLAND.**—Employment at the foundries is benefiting slightly by the increase in activity at the shipbuilding yards. There has been no change in the price of No. 3 Scottish foundry iron, which remains at 65s. f.o.r. furnaces, with 2s. 6d. extra for No. 1. The Falkirk founders continue very busy, and have difficulty in getting adequate supplies of iron. No. 3 Cleveland iron is officially quoted at 62s. 3d. at Falkirk and 65s. 3d. at Glasgow, Northamptonshire iron being 1s. 3d. per ton less than these figures.

## Coke.

Foundry coke is now at a slightly higher price in the South Staffordshire area, but buying has slackened down, as many consumers are covered. Best Durham is at 35s. to 39s. 6d. per ton, delivered at Birmingham and Black Country stations, with Welsh coke at 33s. to 46s., according to analysis and quantity, and Scottish low-ash coke at about 39s. per ton.

## Steel.

The situation in the steel markets is developing on satisfactory lines, and trading in practically all departments appears to be increasing in volume. There is a steady call for semi-finished steel, although the activity noticeable in the market a short time ago has died down owing to the majority of the important consumers having contracted for their supplies for some time ahead. A certain amount of business is passing to the Continental works, but the greater part of this is for steel required for special purposes. In the finished-steel market, the home demand is well maintained, and the prices of some materials show a tendency to rise. In this department competition is met with from Continental steelmakers. The volume of export business in still unsatisfactory, but there is a tendency for it to expand.

## Scrap.

Scrap-iron quotations are generally firm throughout the country. In the Cleveland area, ordinary cast-iron scrap is now about 53s. 6d. per ton, machinery metal in handy pieces being quoted at 55s. There continues to be a steady demand in the Midlands, quotations showing no change. In Scotland, there has been a better demand for machinery scrap at about 55s. per ton, higher prices being asked for forward. The demand for scrap iron in South Wales is slightly improved. Heavy cast iron is quoted at 47s. 6d., good machinery scrap at 50s., and light cast-iron scrap at 40s.

## Metals.

**Copper.**—Firmer prices have been seen in the copper market this week. This partly follows on a decline in the sterling exchange, but there has also been an increase in the industrial demand for copper, both in Europe and in the United States. Dollar fluctuations are likely to affect copper quotations in London for some little time.

Progress is being made with the scheme for the standardisation of the United States copper industry. An organisation known as the United States Copper Association has been formed, by the producing companies and the Customs smelters, to speak for the industry in the forthcoming discussions at Washington on the proposed "copper code." It is reported that there continues to be a strong probability of a minimum price of 9 cents per lb., delivered in U.S.A., being fixed, and forward copper quotations in the States are stronger.

The week's prices have been as follow :—

*Cash.*—Thursday, £32 18s. 9d. to £33; Friday, £33 5s. to £33 7s. 6d.; Monday, £33 5s. to £33 7s. 6d.; Tuesday, £32 18s. 9d. to £33; Wednesday, £33 16s. 3d. to £33 17s. 6d.

*Three Months.*—Thursday, £33 1s. 3d. to £33 2s. 6d.; Friday, £33 7s. 6d. to £33 10s.; Monday, £33 8s. 9d. to £33 10s.; Tuesday, £33 2s. 6d. to £33 3s. 9d.; Wednesday, £33 18s. 9d. to £34.

**Tin.**—Business with consumers in this country and on the Continent is fairly well maintained, and though quiet conditions have prevailed in America, buyers have inclined to take a more active interest. The firm undertone is well maintained and, though the higher prices have brought out some fairly substantial selling and liquidation, offerings were readily absorbed, the market receiving a fair measure of influential support. The outlook is still regarded favourably, for the future offers a fair prospect of gradual improvement in consumption, and even if this were not so, the quota system of production would, apart from any possible Pool operations, no doubt be adjusted to meet any change in the situation, state Messrs. Rudolf Wolff & Company, in their weekly report.

Daily quotations :—

*Cash.*—Thursday, £228 2s. 6d. to £228 5s.; Friday, £228 2s. 6d. to £228 5s.; Monday, £227 15s. to £228; Tuesday, £227 12s. 6d. to £227 17s. 6d.; Wednesday, £227 10s. to £227 15s.

*Three Months.*—Thursday, £228 2s. 6d. to £228 5s.; Friday, £227 17s. 6d. to £228; Monday, £227 10s. to £227 12s. 6d.; Tuesday, £227 5s. to £227 10s.; Wednesday, £227 7s. 6d. to £227 10s.

**Spelter.**—The firmer tone in the market is largely due to the better conditions obtaining in the copper and tin sections. Nevertheless, a certain amount of interest has been shown by consumers. The galvanising trade is still in an unsatisfactory position, but many of the brass mills are actively engaged, and have been for some time.

Price fluctuations :—

*Ordinary.*—Thursday, £15 2s. 6d.; Friday, £15 2s. 6d.; Monday, £15; Tuesday, £14 17s. 6d.; Wednesday, £15.

**Lead.**—Fair buying of this metal has been seen, and the market is reasonably steady in tone. Barring a sudden increase in consumption, however, there is little likelihood of an upward move in quotations being seen, as heavy stocks are held by the producers, and the output also is tending upward.

Daily market prices :—

*Soft Foreign (Prompt).*—Thursday, £11 16s. 3d.; Friday, £11 13s. 9d.; Monday, £11 13s. 9d.; Tuesday, £11 12s. 6d.; Wednesday, £11 15s.

## Patent Specifications Accepted

*The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.*

### Mining and Mining Appliances

20,806. ROSS, A., and CLEPHAN, G. Coal-cutting machines. 403,903.

### Metallurgy and Engineering

27,956. GENERAL ELECTRIC COMPANY, LIMITED. Process for coating articles with molybdenum. 402,916.

7,090. ROYEN, DR. H. J. VAN. Hot shaping of a steel. 402,972.

8,619. STEWART AND LLOYDS, LIMITED, and MCLAY, G. S. Manufacture of hot billets and the like. 402,979.

15,943. UNITED STEEL COMPANIES, LIMITED, NORBURN, J. C., and COY, E. R. Profile-forming attachments for lathes 403,021.

16,857. SHEVLIN, J. T. (Siemens-Schuckertwerke Akt.-Ges.). Extrusion presses for use in the manufacture of lead pipes. 403,108.

21,778. VEREINIGTE STAHLWERKE AKT.-GES. Process of, and apparatus for, bright-annealing metals. 403,170.

10,133. SCHEMMANN, W., and KOTTMANN, F. Scaling and fettling machines. 403,263.

11,547. KRUPP AKT.-GES. FRIEDRICH-ALFRED HÜTTE, F. Manufacture of sheet-metal piles. 403,276.

15,981. BUDD MANUFACTURING COMPANY, E. G. Welding. 403,301.

19,157. VEREINIGTE STAHLWERKE AKT.-GES. Tuyere for shaft furnaces. 403,321.

23,477. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Fusion welding. 403,342.

16,262. BURNAND, W. E. Apparatus for the electric heat-treatment of metals. 403,404.

26,347. FIELDEN, F. Cast-metal road surfaces. 403,485.

33,529. RODE, F. J. Sheet-metal drawing presses. 403,516.

33,530. RODE, F. J. Sheet-metal drawing presses. 403,517.

11,709. DEMAG AKT.-GES. Machines for straightening metal and like bars. 403,558.

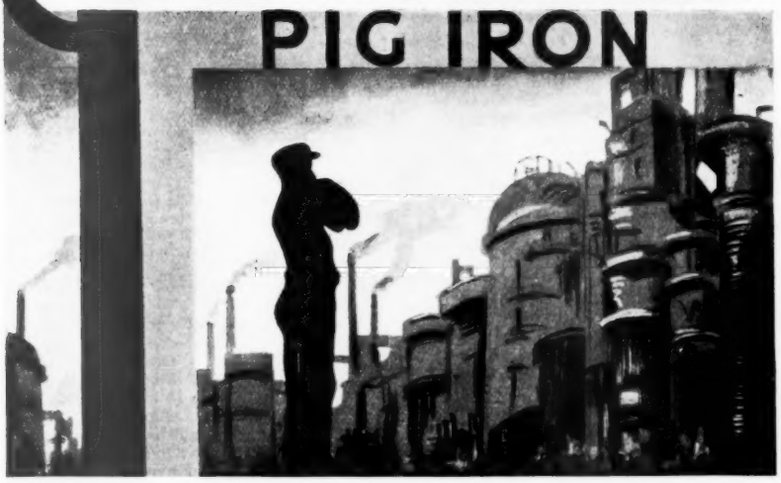
14,451. CLOUSE, W. L. Method of and means for producing blanks for roll-threaded bolts and the like. 403,566.

21,398. HUDSON, W. S., and HUDSON, E. Rims of metal-plate walling, such as that of wagon bodies, tanks and the like. 403,594.

8,864. REPUBLIC STEEL CORPORATION. Process of and an apparatus for making pipe, and the pipe produced thereby. 403,684.

18,293. AKT.-GES FÜR TIEFBOHRTECHNIK UND MASCHINENBAU VORM. TRAUZL & COMPANY. Universal burner cutting and welding machine. 403,695.

# COLVILLES PIG IRON



## BRANDS
DALZELL, GLENGARNOCK
CLYDE & MONKLAND

HIGH GRADE HEMATITE PIG IRON
SPECIAL & ORDINARY FOUNDRY QUALITIES & FORGE
SPECIAL REFINED WITH TOTAL CARBON
GUARANTEED NOT EXCEEDING 3% MAX.

HEAD OFFICE:—
195, W. GEORGE ST., GLASGOW
'PHONE: CENTRAL 9280 'GRAMS: "COLVILLETT" GLASGOW

*Write for our Illustrated Booklet*

# CAST IRON FLANGED PIPES
## 2 in.—12 in. & CONNECTIONS. to 24 in. dia.
*WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.*
## JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

# Mr. Pattern Maker,

What's at the bottom of the Jar?

If you have hitherto made your own PATTERN VARNISH have you not found a thick deposit of insoluble matter at the bottom of the jar?

You have paid for it, but can never use it — you wouldn't care to risk spoiling the job.

PATTERN making is a specialised business, so is the making of PATTERN VARNISHES.

Leave it to experts then— and USE ALL you buy.

***Samples on request.***

*Please send Liquid and applied Samples as offered: to*

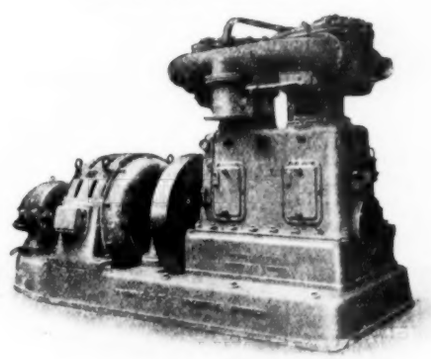
M.....

.....

.....

Messrs. W. PICKARD & Co., Ltd., RUTLAND ROAD, SHEFFIELD.

# COMPRESSORS
## & DRY VACUUM PUMPS
FOR AIR OR GASES



These Vertical double-acting crosshead type compressors are built as single and two-stage machines for pressures up to 40 and 120 lbs. per sq. in. They are built in a range of sizes for capacities up to 10,000 and 5,000 cu. ft. per minute respectively.

*For particulars of these machines and for other types write to :—Ref. Y.*

## REAVELL & CO., LTD.,
RANELAGH WORKS, IPSWICH
Telegrams: "Reavell Ipswich." 'Phone: 2124 Ipswich.


XUM

# RAW MATERIALS—PRICE LIST.

(Wednesday, January 24, 1934.)

## COPPER.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 33 | 16 | 3 |
| Three months | 33 | 18 | 9 |
| Electrolytic | 37 | 0 | 0 |
| Tough | 35 | 15 | 0 |
| Best selected | 36 | 5 | 0 |
| Sheets | 62 | 0 | 0 |
| India | 45 | 10 | 0 |
| Wire bars | 36 | 15 | 0 |
| Ingot bars | 36 | 15 | 0 |
| H.C. wire rods | 39 | 7 | 6 |
| Off. av. cash, December | 31 | 6 | 11 13/19 |
| Do., 3 mths., December | 31 | 9 | 5 13/19 |
| Do., Sttlmnt., December | 31 | 6 | 11 13/19 |
| Do., Electro, December | 34 | 14 | 2 10/19 |
| Do., B.S., December | 34 | 1 | 11⅛ |
| Do., wire bars, December | 35 | 1 | 10 15/16 |
| Solid drawn tubes | | | 10d. |
| Brazed tubes | | | 10d. |
| Wire | | | 6¼d. |

## BRASS.

| | |
|---|---|
| Solid drawn tubes | 9d. |
| Brazed tubes | 11d. |
| Rods, drawn | 8½d. |
| Rods, extd. or rlld. | 4½d. |
| Sheets to 10 w.g. | 7½d. |
| Wire | 7½d. |
| Rolled metal | 7d. |
| Yellow metal rods | 4½d. |
| Do. 4 × 4 Squares | 5½d. |
| Do. 4 × 3 Sheets | 5¼d. |

## TIN.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 227 | 10 | 0 |
| Three months | 227 | 7 | 6 |
| English | 228 | 5 | 0 |
| Bars | 229 | 5 | 0 |
| Straits | 232 | 7 | 6 |
| Australian (nom.) | | | — |
| Eastern | 230 | 10 | 0 |
| Banca | 232 | 2 | 6 |
| Off. av. cash, December | 227 | 14 | 10 8/19 |
| Do., 3 mths., December | 227 | 15 | 7 17/19 |
| Do., Sttlmt., December | 227 | 14 | 5 13/19 |

## SPELTER.

| | £ | s. | d. |
|---|---|---|---|
| Ordinary | 15 | 0 | 0 |
| Remelted | 14 | 15 | 0 |
| Hard | 12 | 5 | 0 |
| Electro 99.9 | 17 | 2 | 6 |
| English | 15 | 12 | 6 |
| India | 14 | 0 | 0 |
| Zinc dust | 20 | 0 | 0 |
| Zinc ashes | 3 | 5 | 0 |
| Off. aver., December | 14 | 16 | 6 3/19 |
| Aver. spot, December | 14 | 18 | 10 7/38 |

## LEAD.

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt. | 11 | 15 | 0 |
| Empire | 11 | 17 | 6 |
| English | 13 | 0 | 0 |
| Off. average, December | 11 | 8 | 7 8/19 |
| Average spot, December | 11 | 10 | 10 13/38 |

## ALUMINIUM.

| | |
|---|---|
| Ingots | £100 to £105 |
| Wire | 1/1 to 1/9 lb. |
| Sheet and foil | 1/2 to 2/9 lb. |

## ZINC SHEETS, &c.

| | £ | s. | d. |
|---|---|---|---|
| Zinc sheets, English | 24 | 10 | 0 |
| Do., V.M. ex whse. | 23 | 5 | 0 |
| Rods | 28 | 15 | 0 |

## ANTIMONY.

| | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| English | 37 | 10 | 0 | to 40 | 0 | 0 | |
| Chinese, ex-whse. | | | | | 26 | 10 | 0 |
| Crude | | | | | 20 | 0 | 0 |

## QUICKSILVER.

| | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| Quicksilver | 9 | 0 | 0 | to 9 | 7 | 6 | |

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | |
|---|---|
| Ferro-silicon— | |
| 25% | £6 10 0 |
| 45/50% | £13 0 0 |
| 75% | £18 2 6 |
| Ferro-vanadium— | |
| 35 50% | 12/8 lb. Va. |
| Ferro-molybdenum— | |
| 70/75% carbon-free of Mo. | 5/6 per lb. |
| Ferro-titanium— | |
| 23/25% carbon-free | 9d. lb. |
| Ferro-phosphorus, 20/25% | £14 10 0 |
| Ferro-tungsten— | |
| 80/85% | 2/6 lb. |
| Tungsten metal powder— | |
| 98/99% | 2/9 lb. |
| Ferro-chrome— | |
| 2/4% car. | £32 0 0 |
| 4/6% car. | £23 0 0 |
| 6/8% car. | £21 12 6 |
| 8/10% car. | £21 12 6 |
| Ferro-chrome— | |
| Max. 2% car. | £34 10 0 |
| Max. 1% car. | £35 12 6 |
| Max. 0.70% car. | £37 10 0 |
| 70% carbon-free | 10½d. lb. |
| Nickel—99.5/100% | £225 to £230 |
| " F " nickel shot | £202 10 0 |
| Ferro-cobalt, 98/99% | 5/- lb. |
| Metallic chromium— | |
| 96/98% | 2/8 lb. |
| Ferro-manganese (net)— | |
| 76/80% loose | £10 15 0 to £11 5 0 |
| 76/80% packed | £11 15 0 to £12 5 0 |
| 76/80% export (nom.) | £9 15 0 |
| Metallic manganese— | |
| 94/96% carbon-free | 1/2 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL.

| | |
|---|---|
| Finished bars, 14% tungsten | 2s. 0d. |
| Finished bars, 18% tungsten | 2s. 9d. |

Per lb. net, d/d buyers' works.

| | |
|---|---|
| Extras— | |
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to 1/16 in. | 1/- lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. | 3d. lb. |
| Do., under ⅛ in. × ¼ in. | 1/- lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP.

| | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| South Wales— | | | | | | | |
| Heavy steel | | | | | 2 | 15 | 0 |
| Bundled steel and shrngs. | 2 | 2 | 6 | to 2 | 15 | 0 | |
| Mixed iron and steel | | | | | 2 | 10 | 0 |
| Heavy cast iron | | | | | 2 | 7 | 6 |
| Good machinery | | | | | 2 | 10 | 0 |
| Cleveland— | | | | | | | |
| Heavy steel | 2 | 16 | 0 | to 2 | 17 | 6 | |
| Steel turnings | | | | | 1 | 15 | 0 |
| Cast-iron borings | | | | | 1 | 5 | 0 |
| Heavy forge | | | | | 2 | 10 | 0 |
| W.I. piling scrap | | | | | 2 | 5 | 0 |
| Cast-iron scrap | 2 | 13 | 6 | to 2 | 15 | 0 | |
| Midlands— | | | | | | | |
| Light cast-iron scrap | | | | | 2 | 2 | 6 |
| Heavy wrought iron | | | | | 2 | 15 | 0 |
| Steel turnings, f.o.r. | | | | | 1 | 13 | 6 |
| Scotland— | | | | | | | |
| Heavy steel | | | | | 2 | 12 | 6 |
| Ordinary cast iron | | | | | 2 | 12 | 6 |
| Engineers' turnings | | | | | 2 | 0 | 0 |
| Cast-iron borings | 1 | 18 | 9 | to 2 | 0 | 0 | |
| Wrought-iron piling | | | | | 2 | 12 | 6 |
| Heavy machinery | | | | | 2 | 15 | 0 |

London—Merchants' buying prices, delivered yard.

| | £ | s. | d. |
|---|---|---|---|
| Copper (clean) | 26 | 0 | 0 |
| Brass | 19 | 10 | 0 |
| Lead (less usual draft) | 10 | 15 | 0 |
| Tea lead | 8 | 0 | 0 |
| Zinc | 10 | 0 | 0 |
| New aluminium cuttings | 68 | 0 | 0 |
| Braziery copper | 24 | 0 | 0 |
| Gunmetal | 24 | 0 | 0 |
| Hollow pewter | 150 | 0 | 0 |
| Shaped black pewter | 106 | 0 | 0 |

## PIG-IRON.

*(f.o.t. unless otherwise stated.)*

| | |
|---|---|
| N.E. Coast (d/d Tees-side area)— | |
| Foundry No. 1 | 65/- |
| Foundry No. 3 | 62/6 |
| " at Falkirk | 62/3 |
| " at Glasgow | 65/3 |
| Foundry No. 4 | 61/6 |
| Forge No. 4 | 61/6 |
| Hematite No. 1, f.o.t. | 63/- |
| Hematite M/Nos., f.o.t. | 62/6 |
| N.W. Coast— | |
| Hem. M/Nos. d/d Glas. | 70/- |
| " d/d Birm. | 84/6 |
| Malleable iron d/d Birm. | 115/- |
| Midlands (d/d Birmingham dist.)— | |
| Staffs No. 4 forge | 62/- |
| " No. 3 fdry. | 66/- |
| Northants forge | 58/6 |
| " fdry. No. 3 | 62/6 |
| " fdry. No. 1 | 65/6 |
| Derbyshire forge | 62/- |
| " fdry. No. 3 | 66/- |
| " fdry. No. 1 | 69/- |
| Scotland— | |
| Foundry No. 1 | 67/6 |
| " No. 3 | 65/- |
| Hem. M/Nos. d/d | 66/- |
| Sheffield (d/d district)— | |
| Derby forge | 59/6 |
| " fdry. No. 3 | 63/6 |
| Lincs forge | 59/6 |
| " fdry. No. 3 | 63/6 |
| E.C. hematite | 76/6 |
| W.C. hematite | 83/6 |
| Lancashire (d/d eq. Man.)— | |
| Derby fdry. No. 3 | 67/- |
| Staffs fdry. No. 3 | 67/- |
| Northants fdry. No. 3 | 65/6 |
| Cleveland fdry. No. 3 | 67/- |
| Dalzell, No. 3 (special) | 102/6 to 105/- |
| Glengarnock, No. 3 | 80/- |
| Clyde, No. 3 | 80/- |
| Monkland, No. 3 | 80/- |
| Summerlee, No. 3 | 80/- |
| Eglinton, No. 3 | 80/- |
| Gartsherrie, No. 3 | 80/- |
| Shotts, No. 3 | 80/- |

## FINISHED IRON AND STEEL.

*Usual district deliveries for iron; delivered consumer's station for steel.*

| Iron— | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| Bars (cr.) | 9 | 0 | 0 | to | 9 | 15 | 0 |
| Nut and bolt iron | 6 | 17 | 6 | to | 7 | 10 | 0 |
| Hoops | 10 | 10 | 0 | to | 12 | 0 | 0 |
| Marked bars (Staffs) f.o.t. | | | 12 | 0 | 0 | | |
| Gas strip | 10 | 10 | 0 | to | 12 | 0 | 0 |
| Bolts and nuts, ¾ in. × 4 in. | | | 13 | 15 | 0 | | |
| Steel— | | | | | | | |
| Plates, ship, etc. | 8 | 15 | 0 | to | 8 | 17 | 6 |
| Boiler plts. | 8 | 5 | 0 | to | 8 | 10 | 0 |
| Chequer plts. | | | 10 | 7 | 6 | | |
| Angles | | | 8 | 7 | 6 | | |
| Tees | | | 9 | 7 | 6 | | |
| Joists | | | 8 | 15 | 0 | | |
| Rounds and squares, 3 in. to 5½ in. | | | 9 | 7 | 6 | | |
| Rounds under 3 in. to ¾ in. (Untested) | 7 | 12 | 6 | to | 8 | 5 | 0 |
| Flats—8 in. wide and over | | | 8 | 12 | 6 | | |
| " under 8 in. and over 5 in. | | | 8 | 17 | 6 | | |
| Rails, heavy | 8 | 5 | 0 | to | 8 | 10 | 0 |
| Fishplates | 12 | 0 | 0 | to | 12 | 10 | 0 |
| Hoops (Staffs) | 10 | 10 | 0 | & up. | | | |
| Black sheets, 24g. (4-t. lots) | | | 10 | 5 | 0 | | |
| Galv. cor. shts. ( " ) | | | 12 | 15 | 0 | | |
| Galv. flat shts. ( " ) | | | 13 | 5 | 0 | | |
| Galv. fencing wire, 8g. plain | | | 14 | 0 | 0 | | |
| Billets, soft | 5 | 10 | 0 | to | 5 | 15 | 0 |
| Billets, hard | 6 | 17 | 6 | to | 7 | 2 | 6 |
| Sheet bars | 5 | 0 | 0 | to | 5 | 10 | 0 |
| Tin bars | | | 5 | 0 | 0 | | |

## PHOSPHOR BRONZE.

| | Per lb. basis. |
|---|---|
| Strip | 11d. |
| Sheet to 10 w.g. | 12d. |
| Wire | 11½d. |
| Rods | 11d. |
| Tubes | 15d. |
| Castings | 13d. |

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## NICKEL SILVER, &c.

| | Per lb. |
|---|---|
| Ingots for raising | 7d. to 1/1 |
| Rolled— | |
| To 9 in. wide | 1/1 to 1/7 |
| To 12 in. wide | 1/1½ to 1/7½ |
| To 15 in. wide | 1/1½ to 1/7½ |
| To 18 in. wide | 1/2 to 1/8 |
| To 21 in. wide | 1/2½ to 1/8½ |
| To 25 in. wide | 1/3 to 1/9 |
| Ingots for spoons and forks | 7d. to 1/3½ |
| Ingots rolled to spoon size | 10d. to 1/6½ |
| Wire round— | |
| to 10g. | 1/4½ to 1/11½ |

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

## AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 19.26 |
| No. 2 foundry, Valley | 17.50 |
| No. 2 foundry, Birm. | 13.50 |
| Basic, Valley | 17.00 |
| Bessemer | 19.76 |
| Malleable, Valley | 17.50 |
| Grey forge, Valley | 17.50 |
| Ferro-mang. 80%, seaboard | 85.00 |
| O.-h. rails, h'y, at mill | 36.37½ |
| Billets | 26.00 |
| Sheet bars | 26.00 |
| Wire rods | 36.00 |
| | Cents. |
| Iron bars, Phila. | 1.89 |
| Steel bars | 1.75 |
| Tank plates | 1.70 |
| Beams, etc. | 1.70 |
| Skelp, grooved steel | 1.60 |
| Steel hoops | 1.85 |
| Sheets, black, No. 24 | 2.25 |
| Sheets, galv., No. 24 | 2.85 |
| Wire nails | 2.35 |
| Plain wire | 2.20 |
| Barbed wire, galv. | 2.85 |
| Tinplates, 100-lb. box | $5.25 |

## COKE (at ovens).

| | |
|---|---|
| Welsh foundry | 25/- |
| " furnace | 17/6 to 18/- |
| Durham foundry | 21/- to 25/- |
| " furnace | 17/6 |
| Midlands, foundry | — |
| " furnace | — |

## TINPLATES.

f.o.b. Bristol Channel ports.

| | | | |
|---|---|---|---|
| I.C. cokes | 20×14 | per box | 16/- to 16/3 |
| " | 28×20 | " | 32/- to 32/6 |
| " | 20×10 | " | 23/6 to 23/9 |
| " | 18¾×14 | " | 16/10½ to 17/- |
| C.W. | 20×14 | " | 15/- to 15/1½ |
| " | 28×20 | " | 31/- to 31/3 |
| " | 20×10 | " | 21/9 to 22/- |
| " | 18¾×14 | " | 15/3 to 15/6 |

## SWEDISH CHARCOAL IRON & STEEL.

| | £ | s. | d. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| Pig-iron | £6 | 0 | 0 | to | £7 | 0 | 0 |
| Bars-hammered, basis | £16 | 0 | 0 | to | £16 | 10 | 0 |
| Bars and nail-rods, rolled, basis | £15 | 15 | 0 | to | £16 | 0 | 0 |
| Blooms | £10 | 0 | 0 | to | £12 | 0 | 0 |
| Keg steel | £30 | 0 | 0 | to | £31 | 0 | 0 |
| Faggot steel | £18 | 0 | 0 | to | £23 | 0 | 0 |
| Bars and rods dead soft, st'l | £10 | 0 | 0 | to | £12 | 0 | 0 |

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

## DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 32 | 18 | 9 | inc. | 15/- |
| ,, | 19 .. | 33 | 5 | 0 | ,, | 6/3 |
| ,, | 22 .. | 33 | 5 | 0 | No | change |
| ,, | 23 .. | 32 | 18 | 9 | dec. | 6/3 |
| ,, | 24 .. | 33 | 16 | 3 | inc. | 17/6 |

**Electrolytic Copper.**

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 36 | 0 | 0 | inc. | 15/- |
| ,, | 19 .. | 36 | 10 | 0 | ,, | 10/- |
| ,, | 22 .. | 36 | 0 | 0 | dec. | 10/- |
| ,, | 23 .. | 36 | 0 | 0 | No | change |
| ,, | 24 .. | 37 | 0 | 0 | inc. | 20/- |

**Standard Tin** (cash).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 228 | 2 | 6 | inc. | 12/6 |
| ,, | 19 .. | 228 | 2 | 6 | No | change |
| ,, | 22 .. | 227 | 15 | 0 | dec. | 7/6 |
| ,, | 23 .. | 227 | 12 | 6 | ,, | 2/6 |
| ,, | 24 .. | 227 | 10 | 0 | ,, | 2/6 |

**Tin** (English ingots).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 228 | 15 | 0 | inc. | 15/- |
| ,, | 19 .. | 228 | 15 | 0 | No | change |
| ,, | 22 .. | 228 | 5 | 0 | dec. | 10/- |
| ,, | 23 .. | 228 | 5 | 0 | No | change |
| ,, | 24 .. | 228 | 5 | 0 | ,, | ,, |

**Spelter** (ordinary).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 15 | 2 | 6 | inc. | 7/6 |
| ,, | 19 .. | 15 | 2 | 6 | No | change |
| ,, | 22 .. | 15 | 0 | 0 | dec. | 2/6 |
| ,, | 23 .. | 14 | 17 | 6 | ,, | 2/6 |
| ,, | 24 .. | 15 | 0 | 0 | inc. | 2/6 |

**Spelter** (Electro, 99.9 per cent.).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 17 | 5 | 0 | inc. | 7/6 |
| ,, | 19 .. | 17 | 5 | 0 | No | change |
| ,, | 22 .. | 17 | 2 | 6 | dec. | 2/6 |
| ,, | 23 .. | 17 | 2 | 6 | No | change |
| ,, | 24 .. | 17 | 2 | 6 | ,, | ,, |

**Zinc Sheets** (English).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 24 | 10 | 0 | No | change |
| ,, | 19 .. | 24 | 10 | 0 | ,, | ,, |
| ,, | 22 .. | 24 | 10 | 0 | ,, | ,, |
| ,, | 23 .. | 24 | 10 | 0 | ,, | ,, |
| ,, | 24 .. | 24 | 10 | 0 | ,, | ,, |

**Lead** (English).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 18 .. | 13 | 5 | 0 | inc. | 10/- |
| ,, | 19 .. | 13 | 0 | 0 | dec. | 5/- |
| ,, | 22 .. | 13 | 0 | 0 | No | change |
| ,, | 23 .. | 13 | 0 | 0 | ,, | ,, |
| ,, | 24 .. | 13 | 0 | 0 | ,, | ,, |

## AVERAGE MONTHLY PRICES OF IRON HOOPS.

| Year | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yearly average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1897 .. .. | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 |
| 1898 .. .. | 6 10 0 | 6 10 0 | 6 10 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 15 0 | 6 15 0 | 7 0 0 | 6 11 6 |
| 1899 .. .. | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 12 6 | 10 12 6 | 8 12 6 | 8 12 6 | 8 12 6 | 9 2 6 | 9 7 6 | 9 17 6 | 8 2 9 |
| 1900 .. .. | 9 17 6 | 10 7 6 | 10 7 6 | 10 7 0 | 10 12 6 | 7 12 6 | 10 12 6 | 10 12 6 | 10 12 6 | 9 17 6 | 9 2 6 | 9 2 6 | 10 3 8 |
| 1901 .. .. | 9 2 6 | 8 2 6 | 8 2 6 | 7 12 6 | 7 12 6 | 7 12 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 11 2 |
| 1902 .. .. | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 |
| 1903 .. .. | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 0 |
| 1904 .. .. | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 | 7 2 6 |
| 1905 .. .. | 6 17 6 | 7 0 0 | 7 0 0 | 7 0 6 | 7 0 0 | 7 0 0 | 7 2 6 | 7 2 6 | 7 2 6 | 7 7 6 | 7 0 0 | 7 7 6 | 7 2 0½ |
| 1906 .. .. | 7 10 0 | 7 17 6 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 7 15 0 | 8 7 6 | 7 15 1½ |
| 1907 .. .. | 8 7 6 | 8 7 6 | 8 7 6 | 8 7 0 | 8 7 6 | 8 7 6 | 8 10 0 | 8 10 0 | 8 10 0 | 8 5 0 | 8 5 0 | 8 0 0 | 8 7 1 |
| 1908 .. .. | 8 0 0 | 7 10 0 | 7 10 0 | 7 10 6 | 7 10 0 | 7 10 0 | 7 10 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 6 8 |
| 1909 .. .. | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 | 7 0 0 |
| 1910 .. .. | 7 1 10½ | 7 6 3 | 7 7 6 | 7 7 0 | 7 7 6 | 7 7 6 | 7 7 6 | 7 7 6 | 7 7 6 | 7 6 3 | 7 5 0 | 7 5 0 | 7 6 5 |
| 1911 .. .. | 7 5 0 | 7 5 0 | 7 5 0 | 7 5 6 | 7 5 0 | 7 5 0 | 7 5 0 | 7 5 0 | 7 5 0 | 7 8 9 | 7 10 0 | 7 10 0 | 7 6 2½ |
| 1912 .. .. | 7 12 6 | 7 12 6 | 7 12 6 | 7 15 0 | 7 15 0 | 8 2 6 | 8 2 6 | 8 2 6 | 8 12 6 | 8 12 6 | 8 12 6 | 8 15 0 | 8 2 3½ |
| 1913 .. .. | 8 17 6 | 8 17 6 | 8 17 6 | 8 17 0 | 8 17 6 | 8 17 6 | 8 17 6 | 8 7 6 | 8 7 6 | 8 7 6 | 8 7 6 | 7 17 6 | 8 12 6 |
| 1914 .. .. | 7 17 6 | 7 17 6 | 7 17 6 | 7 13 9 | 7 12 6 | 7 12 6 | 7 12 6 | 9 2 6 | 9 2 6 | 9 2 6 | 9 2 6 | 9 2 6 | 8 6 4½ |
| 1915 .. .. | 9 3 6 | 9 18 1 | 10 7 6 | 10 16 6 | 10 17 6 | 13 2 6 | 13 2 6 | 13 2 6 | 13 7 6 | 14 2 6 | 15 2 6 | 15 18 6 | 12 10 1 |
| 1916 .. .. | 17 2 6 | 17 2 6 | 17 2 6 | 17 6 3 | 17 7 6 | 17 7 6 | 17 7 6 | 17 7 6 | 17 7 6 | 17 7 6 | 17 7 6 | 17 7 6 | 17 6 1 |
| 1917 .. .. | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 |
| 1918 .. .. | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 |
| 1919 .. .. | 17 2 6 | 17 2 6 | 17 2 6 | 17 2 6 | 24 6 3 | 24 6 3 | 24 6 3 | 25 9 0 | 26 7 6 | 26 7 6 | 26 7 6 | 26 17 4 | 22 14 9 |
| 1920 .. .. | 28 0 0 | 28 12 6 | 33 15 0 | 35 5 0 | 35 15 10 | 38 17 6 | 38 17 6 | 38 17 6 | 38 17 6 | 38 17 6 | 36 17 6 | 36 17 6 | 35 14 9 |
| 1921 .. .. | 29 1 3 | 23 5 0 | 21 12 6 | 20 0 0 | 20 0 0 | 20 0 0 | 17 5 0 | 15 0 0 | 14 4 0 | 13 15 0 | 13 10 0 | 12 18 0 | 17 5 10 |
| 1922 .. .. | 16 5 0 | 15 13 9 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 13 4 6½ |
| 1923 .. .. | 14 0 0 | 15 0 0 | 15 0 0 | 15 0 0 | 15 6 0 | 15 0 0 | 15 0 0 | 15 0 0 | 15 0 0 | 15 0 0 | 14 16 0 | 14 15 0 | 14 18 3½ |
| 1924 .. .. | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 15 0 | 14 13 9 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 12 4½ |
| 1925 .. .. | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 6 |
| 1926 .. .. | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 |
| 1927 .. .. | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 14 10 0 | 12 10 0 | 12 10 0 | 14 3 4 |
| 1928 .. .. | 12 10 0 | 12 7 6 | 12 0 0 | 11 13 6 | 11 15 0 | 11 12 6 | 11 10 0 | 11 10 0 | 11 10 0 | 11 10 0 | 11 10 0 | 11 10 0 | 11 14 10½ |
| 1929 .. .. | 11 10 0 | 11 10 0 | 11 10 0 | 11 10 0 | 11 9 0 | 11 5 0 | 11 5 0 | 11 5 0 | 11 5 0 | 11 2 0 | 11 0 0 | 11 0 0 | 11 5 11 |
| 1930 .. .. | 11 0 0 | 11 0 0 | 11 0 0 | 10 16 3 | 10 15 0 | 10 15 0 | 10 15 0 | 10 15 0 | 10 15 0 | 10 15 0 | 10 15 0 | 10 15 0 | 10 16 4½ |
| 1931 .. .. | 10 15 0 | 10 15 0 | 10 15 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 11 3 |
| 1932 .. .. | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 9 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 |
| 1933 .. .. | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 | 10 10 0 |


WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

LIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

## Notice.

**Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-**

***(A remittance should accompany instructions.)***

### SITUATIONS VACANT AND WANTED.

ADVERTISER (39), with sound practical patternshop and foundry experience, also a little commercial knowledge, seeks any post where above experience useful.—Box 626, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ADVERTISER, well established among ironfounders, with travelling Midland Counties and Lancashire, is desirous of selling pig-iron for a blast-furnace company.—Address, Box 630, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Foreman, or Melter, desires change, for the manufacture of nickel chromes, pure nickel, copper nickel, alloys, etc.; fully experienced on Héroult or high-frequency furnaces; 12 years' experience.—Box 622, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FIRM of Ironfounders have vacancy for Young Man on commercial side to deal with correspondence, progress work, etc.; previous experience necessary, and preference given to one able to purchase shares in the company. Excellent opportunity to rise to directorship.—State full details to Box 598, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVES required in Scotland, Yorkshire, London and District, Lancs and Cheshire for sale of Foundry Parting Powder, Core Binders and other foundry requisites. Only those with knowledge and connection. High commission paid to suitable representatives.—Box 614, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Foundry Foreman for small ironfoundry making general engineering castings. State age, experience and wages required. — Box 624, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### PATENT.

THE Owners of British Patent No. 304,302, relating to "Improvements in Ingot Moulds," are desirous of entering into negotiations for the grant of Licences or otherwise, under suitable terms, for the purpose of exploiting the invention and ensuring its full development and practical working in this country.—For particulars, address, ARTHUR SADLER, 65, Temple Row, Birmingham 2.

### PROPERTY.

**MAGNIFICENT**

**11 ACRES WORKS SITE.**

**SHEFFIELD.**

**145,000 Sq. Ft. of Shops.**

**SIDING CONNECTIONS**

**with L.M. & S. and L. & N.E. Rlys.**

**WELL-BUILT & COMMODIOUS OFFICES**

**Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.**

**Apply—**

**THOS. W. WARD, LTD.,**

**ALBION WORKS, SHEFFIELD.**

### FINANCIAL.

CAPITAL offered, with active services, up to £1,500, in business which is established and making net profit.—Write, Box 1534, WALSH, 65, New Bond Street, London, W.1.

### FOR SALE BY PRIVATE TREATY.

By Direction of TRIPLEX FOUNDRY, LIMITED, GREAT BRIDGE, STAFFS, who are shortly removing to their New Foundry at Tipton.

FOR SALE BY PRIVATE TREATY, WITH POSSESSION ON COMPLETION.

The Substantially-built and Extensive FREEHOLD MANUFACTURING PREMISES,

Situate at Bridge Road and Toll End Road, GREAT BRIDGE, TIPTON, STAFFS,

COMPRISING A TOTAL AREA OF 20,900 SQUARE YARDS

with RUNWAYS and FIRST-CLASS MELTING PLANT by arrangement if required).

There is a frontage to Canal Basin of about 1,000 ft. The distance from the L.M. & S. and G.W.R. Goods Stations at Great Bridge is ¼-mile, and services include South Staffs and Canal Water Supplies, Gas and Electric Light and Power.

First-class South Staffordshire labour is available in the district.

Further particulars and Permits to Inspect may be obtained from J. V. BOSWELL & COMPANY, F.A.I., Auctioneers and Valuers, 4, Waterloo Road, Wolverhampton (Telephone 21216/7), or MESSRS. CHESSHIRE, GIBSON & COMPANY, F.A.I., Auctioneers and Valuers, 21, Waterloo Street, Birmingham (Telephone Midland 6651/2).

### MACHINERY.

## SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

## SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.

Rotoil "Senior" Oil Core Sand Mixer.

Pneulec Sand Drying Plant, output 1 ton per hour.

Brearley Type Disintegrators.

## MOULDING MACHINES

Hand and Pneumatic Types.

Also

Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.

Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

## AIR COMPRESSORS

All sizes for high and low pressures.

**S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.**

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

## THOS. W. WARD, LTD.

High-speed GUILLOTINE SHEARS, cap. 5′ plates x $\frac{3}{16}$″ thick.

"Ever-ready" Table SURFACE GRINDER, cup wheels 20″ and 14″ dia.

Pneumatic SAND MOULDING MACHINE, admits pattern boxes 16″ x 16″ x 6″.

Nearly new High-class Steam Tractor VERT. BOILER, about 5′ 6″ high x 2′ 10½″ dia., 250 lbs. w.p.

STEEL WIRE ROPES for Winding, Hawsers, etc., in stock.

*Write for "Albion" Catalogue.*

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

### MACHINERY—*Continued.*

WANTED to Purchase, Pneulec Royer Portable Sand Mixer.—Apply, Box 628, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

6-FT. "JACKMAN" Sandblast Rotary Table, good condition; seen working in London; cheap price.—A. HAMMOND, Foundry Machinery Merchant, Slough.

### MISCELLANEOUS.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264

PROCESSES for use in Iron and Non-Ferrous Foundries. — Advertisers have American and Continental processes available and desire to negotiate with British firms for outright sale or to be taken on licence.—Write, Box 616, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PARTING POWDER (genuine and original kind).—Advertisers, having purchased a large quantity, offer to the foundry in minimum lots of 5 cwts. packed in bags at 11s. 6d. per cwt.—Write to Box 612, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED offers for about 4,000 throw-out Galvanised Steel Drums, average weight 102 lbs. each; can be inspected at Trafford Park.—Box 632, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

LINSEED OIL for foundry purposes; spot lot of 40 tons available for immediate delivery in lots of 1 ton and upwards, price £20 per ton, barrels free, delivered works.—Address, Box 610, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNS.—Inferior Patterns make trouble in the foundry. Why not buy the best—they cost very little more.—Send to FURMSTON & LAWLOR, Letchworth, Herts.

'Phone: 287 SLOUGH

## SANDBLAST PLANTS

12′ × 9′ Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

Practically as new, 6′ × 6′ × 8′ Tilghman Sandblast room, similar to above, but with B.H.2 Tilghman horizontal compressor; price complete **£130**. Several small Tilghman plants.

## SAND PLANT

| | |
|---|---|
| Herbert "Whizzer" type disintegrator, No. 1 | £30 |
| Herbert "Whizzer" type disintegrator, No. 2 | £46 |
| Rotary sand mixer and elevator .. .. | £24 |
| Gyratory sand riddle with motor .. .. | £7 |

Large "Baillott" sand preparing plant CHEAP.

***BUY FROM ME AND SAVE MONEY!***

**ALEX. HAMMOND,** *Foundry Machinery Merchant,*

**14, AUSTRALIA ROAD, SLOUGH**

XUM